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EXPERIMENT STATION RECORD.

VOL. IV. AUGUST, 1892. NO. 1.

In the volume of the Record which begins with the present number a change in the arrangement of the material has been inaugurated, by which the abstracts of the publications of the American stations are grouped by topics instead of by stations, as formerly. It is believed that the advantages of the topical arrangement will be readily apparent. It will bring together accounts of investigations on allied subjects, so that they may be more conveniently consulted and compared, and it will make it possible to give prominence to the more important matters. The carrying out of this plan will in many cases necessitate the assignment of different portions of the same publication to different places in the Record, but in every case the table of contents will contain references to all the abstracts of the several publications reviewed in a single number. As heretofore, all station publications received at this Office will be abstracted, so that the record of station work will be none the less complete. It will be readily seen that the complex nature of many of the subjects treated in station publications makes their classification largely a matter of individual judgment. Perfect consistency in the assignment of articles to the several subjects can hardly be expected, but every effort will be made in this direction.

To make the contents of the Record more readily available to those who lack the time for reading detailed abstracts, brief synopses will be prefixed to the longer abstracts wherever the subject matter makes this feasible. The synopsis will give the nature and extent of the experiment and the results obtained, leaving all details to the full abstract. It is hoped that the authors of station publications will generally adopt the plan of attaching brief summaries to the accounts of their investigations. A succinct statement of the points which the author wishes to make is often the best guide to the interpretation of his detailed statements.

As the work of this Office has developed and the editorial staff has been increased a division of duty has been made in accordance with the taste and acquirements of the several members of the force. As far as practicable opportunities have been given for work in special lines. It now seems desirable to indicate in the Record the departments of work which are especially assigned to individuals and for which they are responsible. It will be understood that no attempt has been made to show exactly the share of each worker in the preparation of the Record, but rather to point out the subjects to which individuals are giving their most careful attention.

It is of course impracticable to give credit for the large amount of labor expended in editorial oversight and painstaking elaboration of details. It is hoped that it will be possible in the future to make a still further division of our work according to special subjects, and that each worker will have opportunity to traverse the literature of his chosen field.

On page 6 is a translation of a communication from the pen of Prof. Julius Kühn, director of the Agricultural Institute of the University of Halle, Germany, on feeding standards for domestic animals. Coming from a recognized authority upon this subject, the article is intrinsically one of decided interest. It is made still more valuable by the facts that it presents a side of the subject which is too often overlooked by our experiment stations and agricultural writers, and that the reasons for the views urged are so clearly stated and are so well attested by the teachings of chemistry and physiology, the results of feeding experiments, and the experience of practical men.

It is now about seventeen years since the first detailed explanation of the German doctrine of feeding standards and rations for domestic animals, which had already become current in that country, was printed in the English language. The ideas were kindly received on this side of the Atlantic and were rapidly promulgated. The feeding standards of Wolff came to be very commonly quoted. Gradually analyses of American feeding stuffs accumulated, and as experiment stations were introduced and gave more or less attention to experiments in feeding, tests were made of the digestibility of our feeding stuffs. To-day we are making use of our own analyses and of the coefficients of digestibility as learned by both our own and European experiments. To apply them we are using almost exclusively the feeding standards of Wolff.

Of the great good that has come from this there can be no possible question, but it is a misfortune that the feeding standards should be followed so blindly as they are by many writers, teachers, and experimenters in the United States. Indeed the figures for average

composition of feeding stuffs and standards for daily rations are often used in such a way as to make the science of cattle feeding little more than a branch of applied mathematics.

Prof. Kühn calls attention to several difficulties in the way of prescribing definite feeding standards for different classes of animals which are fed for different purposes. They have to do with the animals, the feeding stuffs, and the commercial value of the feeding stuffs and the products.

In the first place different animals of the same class differ greatly in their capacity for utilizing food, and even the same animal may require different rations under different conditions. Thus different breeds of milch cows and different cows of the same breed may vary widely with respect to the amounts of food which they can most advantageously utilize. The amount appropriate for 1,000 pounds live weight may be much greater with a small cow than with a large one. It varies with the bodily condition of the animal, whether lean or fat, and with the amount of the milk yield. The quantity of food needed depends also upon whether, as the milk falls off toward the end of the period of lactation, the cow is to be fattened for the butcher or is to be again used for breeding and milking. In brief, it is impossible to lay down hard and fast rules for quantities of food or quantities of nutrients, or for nutritive ratios to apply indiscriminately to different animals under different conditions.

Again, different specimens of any kind of feeding stuff may vary widely in chemical composition so that the figures for average composition may be very far from the truth in a given case. The coefficients of digestibility are likewise variable. And even if the quantities of actually digestible nutrients in any given instance, as determined by either natural or artificial digestion, should be taken as the basis of the calculation they might be very far from expressing the nutritive value of the materials as they are actually utilized by the animal, because of the defects in our present methods of analysis and of classification of the nutrients.

Finally, economical feeding is not simply a matter of fitting the nutrients of the food to the physiological demands, but of adjusting the kinds and quantities of feeding stuffs to their cost and to the amount and market value of the product.

Prof. Kühn's conclusion is that to calculate rations upon a basis of the feeding standards and the average composition of the feeding stuffs, is irrational and may be very unprofitable. He would, however, by no means give up either standards or tables of composition. As regards the quantities of nutrients to be fed, he would take into consideration the individual needs of each animal and make the quantities of total food and of the several nutrients such as will best fit the special demands of the animal for sustenance and production. In calculating the amounts of feeding stuffs to be used he would not simply use the

average figures, but would consider the ranges of variation and the composition of the particular materials to be fed. The ideal method would be to analyze the feeding stuffs in each case, if this were practicable, but it usually is not. But along with the chemistry and physiology of the subject, the skill of the experienced practical feeder is absolutely essential. For the method of "individual feeding" which Prof. Kühn recommends he gives suggestions of no little interest.

One matter which Prof. Kühn rightly insists upon is the distinction between the digestible protein, *i. e.*, total digestible nitrogenous substances, and the digestible actual albuminoids. He also urges with justice that the ether extract of the coarse fodders has a much lower feeding value than that of the concentrated fodders like oil cakes and meals, which consist mostly of the true fats. He insists with like good reason that what we call non-nitrogenous extract represents a great variety of materials of unknown or doubtful value.

Chemists clearly apprehend the difficulty with their analyses as measures of the nutritive value of feeding stuffs, but the experimenters and writers have not always appreciated the full import of the differences in individuality of animals, nor has the importance of taking into account the condition of the individual animal been generally realized. We have learned that there is very little use in preparing formulas for fertilizers for a given plant to be used on different soils. The reason is that soils vary so widely in chemical and physical characters. We are gradually coming to understand that the differences between individual animals of the same kind if not as large as those between different soils, are nevertheless much greater than we formerly supposed. This is a fact which must be taken into account both in our experimenting and in our practical feeding.

One point which Prof. Kühn dwells upon is of especial interest. It is that in the feeding of milch cows the rations should be fitted to the production expected. Instead of a standard giving certain amounts of nutrients per thousand pounds of live weight he proposes to use a basal ration, which will be a little more than a maintenance ration, and to add to this quantities of nutrients proportionate to the wants of each animal and the production expected.

Feeding standards and tables of composition and digestibility are invaluable helps to economical feeding. There is every reason to believe that they will be made more and more useful as experimental inquiry brings us more and more exact information. But they are only helps. They are to be regarded as indications rather than rules. They can not take the place of the skill of the experienced practical feeder. In his treatise on cattle feeding, to which Prof. Kühn refers and which ought to be better known than it is on this side of the Atlantic, the principle is expressed in the German adage, which is taken as the motto of the book: "*Das Auge des Herrn mästet sein Vieh*" (the eye of the master fattens his stock).

There is another important matter in this connection which is occasionally referred to in print and is often thought of by chemists and experimenters, but has not yet been fully explained. It is the effect of considerable quantities of undigestible material in the food upon the nutritive value of the material which is actually digested. Some late experiments by Prof. Zuntz in Berlin throw light upon this as they make it appear probable that not inconsiderable quantities of the potential energy of the digested food are used in providing for the work of digestion and the transfer of the undigested material through the alimentary canal. In other words, when a coarse fodder, like hay or straw, yields a given quantity of actually digestible nutrients to the alimentary apparatus it is not really as valuable for feeding as a concentrated food which would yield the same quantity of digestible nutrients, because so much of the energy is required for the digestion and for the care of the undigested material.*

This has a direct bearing upon the question of the comparative values of the nutrients of different feeding stuffs. The digestible nutrients of such coarse feeding stuffs as hay and straw may have less nutritive effect than the same quantities of the digestible nutrients in a concentrated food like meal, for several reasons. The protein of the coarse fodder may contain a larger proportion of non-albuminoid nitrogen; the ether extract may have less of the true fats; the non-nitrogenous extractives may be of inferior value; and more of the energy of the assimilated material may be consumed in providing for digestion and for the transport of material through the alimentary canal.

Another complex and as yet but partly explained phase of the same general question is the digestion of cellulose and the fermentation of that and other carbohydrates by different animals. It seems that this has an important bearing upon the nutritive values of protein and fats as well as carbohydrates, though the experimental data at hand do not suffice for exact explanations or measurements of the nutritive effects.† Of course the value of the coarse foods for their mechanical action is often an important matter, but that is a separate phase of the subject.

* See Pflüger's Arch. ges. Physiol., 49 (1891) 442.

† See Zuntz., loc. cit., p. 477.

FEEDING STANDARDS FOR DOMESTIC ANIMALS.

PROF. JULIUS KÜHN.

When in the year 1859 Grouven, in his Lectures on Agricultural Chemistry, proposed the first feeding standards, in opposition to the theory of hay equivalents which at that time was prevalent, he inaugurated a most significant advance in the theory of animal nutrition. Although the compounding of rations for animals with reference to the actual amounts of the different nutrients they contain, had been previously suggested by Haubner and had been successfully carried into practice with good results in the feeding of milch cows by a practical farmer, Herr von Lingenthal of Gross-Gmehlen in the Province of Saxony, Prussia, the credit of having recognized the importance of the principle and of having broadened and deepened it and brought it into general recognition, belongs to Grouven. All later progress rests on this basis.

In the calculation of the feeding standards proposed by him, Grouven took for his basis the total quantities of protein, fat, and carbohydrates in feeding stuffs, as indicated by analysis. Later the investigations of Henneberg and Stohman in Weende, showed that these nutrients as determined by analysis, were not digested in the same proportions from different feeding stuffs. For instance, in a series of experiments only 60 per cent of the total nitrogenous constituents found by analysis in meadow hay, 51 per cent of those in clover hay, and as small a proportion as 26 per cent of those in wheat straw, was digested. A large number of experiments made later at different experiment stations confirmed and extended the results obtained at Weende. Henneberg proposed to distinguish between amounts of the several nutrients found by analysis, which he designated as crude, *e. g.*, crude protein, crude fat, etc., and the portions which were digestible, and to use only the digestible nutrients in the calculation of feeding rations. Grouven, however, retained in the third edition of his work (1872) the standards which he previously proposed and which refer to crude nutrients. Wolff, who had given up the theory of hay equivalents which he with others had formerly followed, constructed new feeding standards based on the amounts of digestible nutrients.

The standards of both Grouven and Wolff have the feature in common, that as an aid to the farmer in making up his rations they give absolute, definite figures for the total quantity of the food and of the separate nutrients to be fed. They fix these figures once for all and offer them

as a norm for the calculation of rations. Thus for a milch cow per 1,000 pounds live weight, there are to be fed, according to Grouven, 27 pounds dry substance, 2.74 pounds crude protein, 0.84 pound crude fat, and 14.34 pounds carbohydrates, with a nutritive ratio of 1:6; and according to Wolff, 24 pounds organic substance, 2.5 pounds digestible protein, 0.4 pound digestible fat, and 12.5 pounds digestible nitrogen-free extract, with a nutritive ratio of 1:5.4.

Precisely this characteristic of the feeding standards of Grouven and Wolff, namely, the setting up of standards for use in all cases, is, in the opinion of the writer, objectionable and misleading to the farmer. Such standards lead him to believe that he has a reliable means for a convenient and simple calculation of the rations for his animals, whereas he should be aware that in using them he rests on very uncertain ground, and that to use them with success he must take carefully into account the existing conditions, especially the quality of the feeding stuffs at his disposal, and the capacity of his animals both for utilizing food and for production. These factors should be carefully studied and decided for each individual case. How important this is will appear from the considerations that follow.

In the first place Wolff is hardly correct in basing the quantity of food on the total *organic substance* instead of on the *dry substance.* The mineral matter besides affecting the quality of the fodder, also contains certain ingredients indispensable to the animal organism, such as phosphoric acid, lime, iron, etc., and are not without effect on the digestion. For instance, the epidermal cells of coarse fodder, which are rich in silica, promote peristaltic movement of the intestines and favor intestinal digestion. The amount of dry matter, as was suggested by the investigations of Lingenthal and Grouven, is therefore the only measure which can be taken for the total amount of fodder.

But whether the food be measured by the amount of dry matter or by the amount of organic matter, the fixing of a definite amount of fodder as a standard, applicable in different cases and conditions, is in itself erroneous. It is as truly wrong to say that a cow of 1,000 pounds live weight requires 27 pounds of dry substance as it is to say that she requires 24 pounds of organic substance, for the quantity of food may vary greatly from this and the nutrition of the animal still be in every respect normal, provided the quantity of food received contains digestible nutrients in the requisite amounts and in suitable proportion. Thus, the quantity of dry substance fed to a milch cow per 1,000 pounds live weight may vary from 20 to 33.5 pounds and within even wider limits. This matter was referred to by the writer in the first edition of his book, *Die zweckmässigste Ernährung des Rindviehes*, which appeared in 1861. Clearness on this point is of the utmost practical importance, for the allowable range in quantity of dry matter referred to above makes it possible to adjust the daily rations of our domestic animals to fit the quantities of fodder harvested and at the feeder's disposal at

different seasons of the year. So long as frequent and abrupt changes in the amount of dry matter are avoided, larger amounts of dry matter may be fed when the crops of coarse fodder are abundant and smaller amounts when the harvests are short, without any disadvantage. It will not do to increase the quantity of coarse fodder as much in the case of animals which have been raised on more concentrated food, as in the case of those which have been accustomed to a more bulky fodder, but even with the latter there is great latitude for variation in the quantity of dry substance. The nearer the lower limit is approached the more important it becomes that a liberal amount of the dry substance be given in the form of coarse fodder, as has previously been remarked by the writer.*

For more than a quarter of a century the writer has, in the successive editions of the work referred to, protested that it is not wise to prescribe definite quantities of the several food ingredients as norms to apply to all cases in the feeding of domestic animals kept for different purposes. For the individual nutrients, as for the total amount of food, it is essential to determine the amount for each individual case, and in doing this the particular conditions should be considered.

As regards the nitrogenous materials, it is, in the writer's judgment, to be regretted that Wolff, even in his most recent standards, published in Mentzel and von Lengerke's *Kalender* (1892, I, p. 112), makes no distinction between digestible albuminoids and the amide compounds, but classes the two together. It can be no longer doubted that the amide compounds are inferior to the albuminoids in nutritive effect, that they can only serve as albuminoid conservers like the carbohydrates, and that furthermore the non-albuminoid protein includes compounds, often in considerable quantities, which do not exert this conserving action and whose value in nutrition is very doubtful. These non-albuminoid bodies occur in beets used for feeding. In his tables of composition of feeding stuffs† Wolff gives the entire amount of protein present in beets (1.1 per cent) as digestible and estimates it at the same price as the albuminoids, although he assumes that on an average about 50.5 per cent of the total nitrogen in beets is in the form of non-albuminoid protein. In the ninth edition of *Die zweckmässigste Ernährung des Rindviehes*, which appeared in 1887, and also in the tenth edition, issued last year, the writer separated the non-albuminoid compounds from the soluble nitrogenous compounds in the calculation of rations, taking only the digestible actual albuminoids into account for protein and placing the non-albuminoid protein with the nitrogen-free extract because it resembles the bodies of that class most nearly in its functions.

Again, whether the digestible albuminoids only or the total digestible nitrogenous constituents be taken into account in the calculation of

* Die zweckmässigste Ernährung des Rindviehes, tenth edition, 1891, p. 85.
† Mentzel u. v. Lengerke's Landw. Kalender, 1892, I, p. 107.

rations, it is incorrect to set up a fixed standard for milch cows of 2.74 pounds of crude protein per 1,000 pounds live weight as Grouven did, or of 2.5 pounds of digestible protein (actual albuminoids and amides) as Wolff does, for even the same cow should not be fed alike at all times, unless indeed she is to be fattened during the period of lactation. A cow of a higher productive capacity must on the average have more protein than one of a lower capacity. However, even the former should not receive the same quantity of protein in her daily ration at all times, but the amount should be adapted to the production. A cow of high productive capacity will, during the period of her largest milk production, require more than 2.5 pounds of digestible protein, including amide compounds (total nitrogenous nutrients), per 1,000 pounds live weight per day. Indeed as high as 2.8 pounds and even more may be wanted. From the middle of the period of lactation the quantity should be gradually diminished; at the time of the falling off of the quantity of milk and approaching dryness, and during the time when she gives no milk, 2.2 and finally 2 pounds of digestible protein per day will prove fully sufficient even though the cow be with calf. Were we to give a cow as large amounts of food when she was dry and pregnant as when she was in full flow of milk, she would not only be maintained in good, thrifty condition, with plump form and smooth hair, but would rapidly lay on fat. Fat cows produce smaller calves and in the beginning of lactation produce less milk than those which have been fed well but not too richly, and which have consequently not been able to grow fat but are in a good medium condition. If, as should always be done, the amides be separated from the actual albuminoids, then 2.4 pounds of digestible albuminoids per 1,000 pounds live weight will be sufficient for a cow of very good productive capacity, and it will only be necessary to exceed this for a time in the case of unusually productive animals. The quantity of digestible actual albuminoids can, as the end of the period of lactation approaches, be gradually diminished to 1.8 pounds, or with less productive cows even to 1.5 pounds per 1,000 pounds live weight.

There is still another aspect of this question to be mentioned. The most productive cows can make advantageous use of increasing quantities of albuminoids only up to certain limits. The last effective additions will have a relatively smaller effect on the secretion of milk than the previous ones. In an experiment made at Möckern with a ration which was in practical use for milch cows but not especially rich in protein, an addition of 1 pound of rape cake per head daily increased the production of milk 1.5 pounds per cow; a further addition of a second pound of rape cake increased the yield of milk another pound, a third one half a pound, and a fourth pound was totally without effect on the flow of milk. The effect of the increase of the rape cake is attributable solely to the protein it contained, as the ration contained sufficient nitrogen-free extract from the beginning. The effect diminished with the amount of rape cake added until it became *nil.* To illustrate

the actual profit from this increase in albuminoids, suppose that the price of rape cake had been high and the prices of milk and butter low, then the financial result from the last pound of rape cake added which increased the milk yield, even when the increased value of the manure is taken into account, would be too small to justify its addition in practice. It would be unprofitable in this case to add all the protein which the cow would respond to in her milk yield. On the other hand, if the prices of concentrated nitrogenous feeding stuffs were low and milk could be disposed of at an unusually high price, it might be advisable and economical to add protein to the food as long as it had any perceptible effect upon the flow of milk. The decision as to the amount of protein to be fed in the ration of milch cows will depend therefore upon the state of the market with reference to concentrated feeding stuffs and dairy products.

A fixed standard for the amount of crude or of digestible fat is likewise inadmissible, whether it be for milch cows or for animals kept for other purposes. The substances dissolved by ether from different feeding stuffs are by no means equal in nutritive value, whether that value is estimated by analyses or by digestion experiments. The digestible ether extract of coarse fodders has a much lower nutritive value than the true oils of seeds and oil cake. For this reason it is advisable, within a certain range, to allow a more liberal amount of fat in a ration which contains much coarse fodder than in one which contains a smaller proportion of coarse fodder but more concentrated feeding stuffs. The supply of digestible ether extract may also be diminished in a ration which supplies considerable amounts of easily soluble carbohydrates, such as sugar or starch.

With the nitrogen-free extract the case is similar. Here likewise it is not admissible to fix upon a single number as a standard applicable to all cases. The constituents included in this group have a very variable constitution in different feeding stuffs. Some are of even questionable nutritive value at best, and to count them all as equivalent to starch or sugar is far from correct. The greater the proportion of easily assimilable carbohydrates in the nitrogen-free extract of a ration, the nearer, within certain limits, may the total amount of food approach the lower limit, and *vice versa.*

In determining the amount of so-called nitrogen-free extract to be fed, the size of the animal is to be taken into consideration. Smaller animals, which have a relatively large body surface exposed in proportion to their weight and which consequently lose more heat by radiation, require a somewhat larger quantity of nutrients and especially of nitrogen-free substance per 1,000 pounds live weight.

If the quantities of digestible actual albuminoids, fat, and nitrogen-free extract to be fed are to be determined by the conditions in each individual case, then it follows that the so-called nutritive ratio, the ratio of the protein to the nitrogen-free constituents of the ration, can

not be fixed for all cases. Hence it is incorrect to attempt to establish an invariable nutritive ratio for any special purpose, as for instance a ratio of 1:5.4 (Wolff) for the production of milk, to apply to all cases. The nutritive ratios, like the quantities of nutrients, may vary within wide limits.

Viewing the above considerations in their various bearings, the only conclusion to be reached is that in feeding animals for whatever purpose *individual feeding* is indispensable. That is to say, the requirements of each animal ought to be carefully considered and so far as practicable the supply of nutrients in the daily ration should be adjusted so as to fit its individual needs. This principle applies to every branch of stock feeding, and especially to the feeding of cows for milk. How this individual feeding may be practically carried out without difficulty is indicated in the following extract from the explanation of this subject in the tenth edition of *Die zweckmässigste Ernährung des Rindviehes* (p. 293).

For milch cows it is advisable first of all to determine the quantity of nutrients which represents the minimum requirements per 1,000 pounds live weight of the animals; that is, the quantity which covers the needs of the cows which are dry or nearly dry, and which while producing little or no milk are usually more or less advanced with calf. This minimum amount may be designated as the *basal ration*. It will naturally be more liberal for breeds of high productive capacity and those which keep up their milk yield well in the latter part of the lactation period and only go dry a short time, than for those of inferior milking qualities. For the latter the basal ration need not contain more than from 1.5 to 1.7 pounds of digestible actual albuminoids per 1,000 pounds live weight, while with the former up to 1.8 pounds, and with breeds of exceptionally high capacity even more will be needed. The same considerations will enter into account in determining the amounts of fat and non-nitrogenous substances for the basal ration. Amounts ranging from the minimum to a medium amount are to be recommended. In addition to this basal ration each cow should receive as much concentrated food as she will yield profitable returns for. The cow of the highest productive capacity will naturally need a larger quantity of nutrients, commensurate with her large production of milk. But the amount of nutrients in the daily ration of one and the same cow should also vary as her milk production varies, being greatest early in the milking period when she is producing the most milk, and gradually decreasing with the advance of the period, until as she becomes dry the concentrated food is discontinued altogether and the basal ration alone is fed. While this means of feeding of course requires attention, it insures the greatest possible profit from the animals, and results in the highest development of the milking qualities of the herd, which being transmitted by heredity, effects a continual improvement of the stock.

To feed an animal highly during the most productive part of lactation pays well, but to feed the entire herd equally well, without regard to individual production, can prove remunerative only when in addition to yielding milk the cows are to be fattened. Otherwise such feeding results in great waste of food, is not infrequently the cause of the low profits in dairying, and makes the barnyard manure expensive.

The system of individual feeding is most easily carried out in practice when each animal has its own separate manger. In the construction of new cow stables this arrangement is very strongly recommended no matter how large the herd may be. At each feeding the extra quantity of concentrated food can then be mixed dry with the chopped fodder in the manger. Where long, continuous mangers, without partitions, are used, the basal ration for each animal, which is the same for all, may be placed in the manger and the additions of concentrated food given twice daily in the watering pails. Or the cows may be grouped according to their productiveness and the stage of the milking period which they are in and those of each group fed together. The rations for each group are then mixed together in the right proportions and fed in long mangers to the cows of that group. Cows which give an extraordinary yield of milk and hence are to have richer food than that given any single group, can then be given the extra amounts of concentrated food in watering pails.

Regarding the choice of concentrated feeding stuffs for supplementing the basal ration, it is advisable to use such as will increase not only the protein in the ration, but also the other nutrients proportionately. For this reason it is advisable to use either single feeding stuffs or mixtures of two which are equally rich in easily digested protein, fat, and carbohydrates. At the same time foods which are known to have a specific action in promoting the secretion of milk should have the preference, so far as the prices will permit.

Another important consideration in the calculation of rations is the variability in composition of feeding stuffs. The average percentage of crude nutrients given by Grouven, and the average calculated percentages of digestible ingredients given by Wolff, furnish questionable data for the calculation of rations. Where the feeding stuffs can be analyzed at an experiment station the determination of their actual composition by analysis is highly recommended; but it often happens that this is impracticable, and in any case only the more important foods will be analyzed, so that the feeder is frequently left more or less to his own judgment as to the quality of the material he feeds. In that case it is better for him to consider the quality of the material and estimate its probable feeding value by means of tables showing the range of variation in composition than to rely exclusively on calculated averages. Considering a knowledge of the maximum and minimum proportions of ingredients found in feeding stuffs to be of value for such estimates, the writer has given them, together with the averages, in a table in his book on feeding, referred to above, since 1864. For

a further consideration of this matter reference is made to pages 134–147 and 363 of the tenth edition of the work.

In the opinion of the writer the calculation of the money value of feeding stuffs according to the composition is decidedly questionable. The results are misleading, and from the manner in which they are derived, wholly unreliable.

In conclusion it may be added that such practical experiments in feeding as have recently been carried out under the direction of experiment stations can do much to advance the interests of farmers, but the too wide application of the results thus obtained is to be guarded against. On many farms in the Province of Saxony, Prussia, no attention is paid to stock-raising, but cows are kept for their milk alone, and as soon as the milk falls off so that they become unprofitable they are sold to the butcher and replaced by new cows purchased from outside. The object in such practice as this is to feed so as to obtain the largest yield and at the same time to prepare the cows ultimately for beef. The rations rich in nutrients and especially in protein which have been found advantageous for this double production of milk and beef, while they may be applicable to other sections where the same general practice is followed, are not suitable where breeding is practiced instead of fattening for beef. In the latter case the rich rations would induce fattening, which instead of being an advantage would be positively detrimental to the object for which the animals were kept.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

BOTANY.

A. C. TRUE, *Editor*.

The acquisition of atmospheric nitrogen by growing plants, C. D. WOODS (*Connecticut Storrs Sta. Report for 1891, pp. 17–28*).

Synopsis.—Experiments are reported with scarlet clover, beans, vetch, and cowpeas grown in sand watered with nutritive solutions with and without nitrogen. All the plants grown without nitrates and most of those grown with nitrates gained nitrogen, which must have come from the air. Only where root tubercles were developed was there any considerable gain in nitrogen.

In continuation of experiments on this subject, reported in Bulletin No. 5 and the Annual Reports of the Station for 1889 and 1890 (E. S. R., vol. I, p. 194; II, p. 396; and III, p. 374), experiments were made in 1891 with scarlet clover, small white "pea" beans, vetch, and cowpeas. These were grown in prepared sea sand and watered with nutritive solutions as previously described, some cultures being grown in unglazed earthen pots and others in glass pots, both with and without nitrogenous manuring. The results are fully tabulated and discussed. The following summary is from the report:

The result of fifty experiments with plants grown in sea sand, all of which were supplied with minerals needed for their development and twenty-two of which were in addition provided with small amounts of nitrogen in the form of nitrates, are given in the table which follows:

Summary of results.

	Number of experiments.	Nitrogen supplied in seed and nutritive solution.	Gain (or loss) of nitrogen.		
			Minimum.	Maximum.	Average.
Without nitrogen in nutritive solution.		*Mg.*	*Mg.*	*Mg.*	*Mg.*
Scarlet clover	18	3–6	8	61	37
Scarlet clover	6	3–6	6	47	24
Vetch	4	8–9	4	22	16
With nitrogen in nutritive solution.					
Scarlet clover	6	41–44	-7	45	21
"Pea" beans	3	52	-5	39	19
Vetch	6	49	18	81	46
Cowpeas	7	48–49	-12	129	78

It will be noticed that all of the plants grown without addition of nitrates gained in nitrogen. Three of the plants supplied with nitrates indicate a loss, while the other nineteen gained nitrogen in varying amounts.

As appears from the results in the above table and from those given in previous reports of experiments here, the following species of plants have been found to either provide themselves with nitrogen where none was supplied except that in the seed, or to gain nitrogen in excess of that supplied in seed and nutritive solution: Peas, cowpeas, beans, vetch, alfalfa, and scarlet clover.

All the legumes and no other plants with which satisfactory trials have been made, have proved capable of acquiring large quantities of nitrogen from the air. The gain has occurred where root tubercles were developed, and without them there has been no gain of any account.

Influence of copper compounds in soils upon vegetation (*New York State Sta. Bul. No. 41, n. ser., Apr., 1892, pp. 35–43, plates 3*).

Synopsis.—A preliminary report on pot experiments with peas, tomatoes, and wheat, grown in soils containing 2 and 5 per cent (by weight) of copper sulphate and in untreated soils. As a rule more seeds germinated in the treated soil, but the plants were not vigorous and had comparatively small root systems. Analyses of tomato and pea plants showed the presence of small quantities of copper in those grown in the treated soil.

In one set of experiments seeds of peas, tomatoes, and wheat were sown in soil containing 5 per cent (by weight) of copper sulphate and in untreated soil. In each case more seeds germinated in the treated than in the untreated soil. The percentage of difference was 17 for peas, 22 for tomatoes, and 12 for wheat. The average length of time required for germination in the untreated soil was 55 per cent less with peas, 11 with tomatoes, and 50 with wheat. Tomatoes germinated in the treated soil and transplanted into untreated soil grew vigorously, while the plants left in the treated soil made scarcely any growth.

In another set of experiments seeds of peas, tomatoes, and wheat were sown in soil containing 2 per cent of copper sulphate. In the treated soil 2 per cent more of peas and 6 of tomatoes but 17 per cent less of wheat germinated than in the untreated soil. There was little difference in the time required for germination in the two soils.

The foliage of all plants grown in the 2 per cent soil mixture was of deeper green than that of the check plants. The foliage of plants grown in the 5 per cent soil mixture also showed a marked difference in color from the check plants grown in untreated soil, and had even a deeper green color than the 2 per cent plants. On the average the leaves were smaller with plants grown in the copper soils than leaves of the check plants. * * *

Peas grown in the 2 per cent soil mixture seemed to be more vigorous for the first few weeks than the check plants grown in untreated soil; they also came to maturity earlier, but finally showed a dwarfed appearance and the yield was less than with the check plants. In the 5 per cent soil mixture the peas grew very slowly, did not ripen any earlier than the check peas, and gave a remarkably insignificant yield both of vine and peas. * * * Plants grown in the copper sulphate soil mixtures were remarkable for the meager development of their root systems. Indeed in some cases they seemed to have hardly any roots—just a few short stubs. When plants grown in the copper soils were removed or thinned out it was discovered that they had a very loose hold on the soil and were easily pulled out by the roots, while the plants growing in check soils had a firm hold on the ground and were frequently

broken off at the top of the ground in the effort to pull them up by the roots. * * * [The tops of tomato plants grown in the treated (5 per cent) soil, when tested by chemical analysis, showed] in the air-dried substance 0.0898 per cent of copper, equivalent to 0.2396 per cent of crystallized copper sulphate. In the check plants no copper was found. Other analyses made are reserved from publication at present till other investigations now in progress are completed. It may be noted, however, that analysis of peas showed the presence of copper both in the vines and in the seeds.

METEOROLOGY—WATER.

Meteorological observations in Connecticut, 1891, E. A. BAILEY (*Connecticut Storrs Sta. Report for 1891, pp. 11-16*).—Brief notes on the weather; a summary of the rainfall at twenty localities in the State during the six months ending October 31, 1891; and a summary of the observations at the station for each month of 1891. The yearly summary is as follows: *Pressure* (inches).—Maximum 92.1, minimum 29.14, mean 30.05. *Air temperature* (degrees F.).—Maximum 92.1, minimum 0.0, mean 47.9. *Humidity.*—Mean relative humidity 77.1. *Precipitation.*—Total (inches) 51.61, number of days on which rain fell, 129. *Weather.*—Number of clear days 142, number of fair days 109, number of cloudy days 114. *Wind* (miles).—Total movement 9,603, maximum velocity 55.

Meteorological record (*Maryland Sta. Report for 1891, pp. 425-429*).—A tabulated record of temperature and rainfall for 1891. The yearly summary is as follows: *Air temperature* (degrees F.).—Maximum 94.5, August 10; minimum 13, February 5; mean 54.3; mean maximum 65; mean minimum 45.3; mean daily range 19.7. *Precipitation.*—Total (inches) 50.55, number of rainy days 128.

Meteorological record (*Massachusetts State Sta. Report for 1891, pp. 340-343*).—Monthly meteorological summary for the year 1891.

Meteorological observations, C. D. WARNER (*Massachusetts Hatch Sta. Met. Bul. No. 41, May, 1892, pp. 4*).—A daily and monthly summary of observations for May at the meteorological observatory of the station.

Meteorological summary for North Carolina, March, 1892, H. B. BATTLE and C. F. VON HERRMANN (*North Carolina Sta. Bul. No. 85a, Apr. 27, 1892, pp. 16*).—Notes on the weather, monthly summary, and tabulated daily records of meteorological observations by the North Carolina weather service, coöperating with the United States Weather Bureau. The bulletin is illustrated with a map of North Carolina showing the isothermal lines and the total precipitation at the stations in different parts of the State.

Analyses of well waters (*Massachusetts State Sta. Report for 1891, pp. 301, 302*).—Tabulated analyses of 68 samples of well water from different parts of the State.

SOILS.

W. H. BEAL, *Editor.*

Soil investigations, M. WHITNEY (*Maryland Sta. Report for 1891, pp. 249–296*).

Synopsis.—A preliminary report on investigations by the station, in coöperation with the U. S. Department of Agriculture and Johns Hopkins University. The work has been on the physical structure of the soil and its relation to the circulation of soil water and the physical effect of fertilizers on soils as related to crop production. The subjects treated in the report are as follows: (1) Circulation of water in the soil; (2) effect of fertilizers on the texture of the soil; (3) volume of empty space in soils; (4) relation of geology to agriculture; (5) soil types; (6) mechanical analysis of the type soils; (7) approximate number of grains per gram of soil; (8) approximate extent of surface area per cubic foot of soil; (9) circulation of water in these type soils; (10) improvement of soils. An attempt is made to classify the soils of Maryland on the basis of their geological origin and agricultural value. The effect of fertilizers in changing the texture of soils and the rate of circulation of water in soils is discussed, and their importance in producing a physical condition of the soil which promotes the growth of the plant is urged.

The circulation of water in the soil (pp. 253–257).—The movement of water in the soil is due to gravity and to surface tension. The nature of these forces and the methods of their action are explained.

Gravity tends to pull the water downward and acts with a constant force per unit mass of water. Surface tension, or the contracting power of any exposed water surface, may move the water in any direction within the soil according to circumstances. It may act, therefore, *with* gravity to pull the water down, or *against* gravity to pull it up. * * *

By numerous careful and verified experiments we have found that fertilizers change this surface tension and modify the contracting power of the free surface of water to a remarkable degree, and so modify the power which moves water from place to place in the soil.

The following table gives the surface tension of a solution in water of several of the ordinary fertilizing materials. This list is not complete and the solutions used were of any convenient strength. The results are preliminary to give material for more thorough and detailed investigation. The surface tension is expressed in grammeters per square meter, that is, on a square meter of liquid surface there is sufficient energy to raise so many grams to the height of one meter.

The surface tension of various solutions.

[Gram-meters per square meter.]

Solution of—	Specific gravity.	Number.*	Mean.	Highest.	Lowest.
Salt	1.070	6	7.975	8.126	7.796
Kainit	1.053	6	7.900	7.998	7.805
Lime	1.002	4	7.696	7.750	7.674
Water	1.000	18	7.668	7.923	7.506
Acid phosphate	1.005	4	7.656	7.800	7.563
Plaster	1.000	9	7.638	7.730	7.572
Soil extract	1.000	5	7.089	7.166	6.969
Ammonia	0.960	6	6.869	6.950	6.825
Urine	1.026	10	6.615	6.740	6.471

* Of measurements from which the mean is taken.

The soil extract was made by shaking up a little soil with just sufficient water to cover it. The water was afterwards filtered off and used for the determination. It will be seen from the table that this contact with the soil reduced the surface tension of water very considerably. There is little doubt that the surface tension of soil moisture is very low, much lower than that of pure water. Salt and kainit, on the other hand, increase the surface tension of water very considerably and raise it far above that of the soil extract. This probably explains the fact, which has been often commented on, that an application of salt or kainit tends to keep the soil more moist. This has often been remarked in connection with the application to a clover sod. By increasing the surface tension of the soil moisture they increase the power the soil has of drawing water up from below in a dry season.

Ammonia and urine lowered the surface tension of water considerably below that of the soil extract and far below that of pure water. This probably also explains a matter of common observation, that the injudicious use of excessive quantities of organic matter is liable to "burn out" a soil in a dry season, because by reducing the surface tension water can less readily be drawn up from below.

This opens up a field of investigation on the determination of the surface tension of the moisture in various soils and a more extensive and more systematic study of the effect of various fertilizing materials on the surface tension of water and soil extract, and it opens up a wide field in its application to practical agriculture and the use of manures and fertilizers.

This effect of fertilizing material in changing the surface tension of a liquid and thereby changing the force or power which moves water from place to place in the soil, is only a first effect, as the continued use of these fertilizing materials may change the texture of the soil itself and the relation of the soil to the circulation of water.

The effect of fertilizers on the texture of the soil (pp. 257–259).

Surface tension may be expressed in another way. The *potential* of a single water particle is the force which would be required to pull it away from the surrounding water particles and remove it beyond their sphere of attraction. For simplicity it may be described as the total force of attraction between a single particle and all other particles which surround it. With this definition it will be seen that the potential of a particle on an exposed surface of water is only one half of the potential in the interior of the mass, as half of the particles which formerly surrounded and attracted it were removed when the other exposed surface of water was separated from it. A particle on an exposed surface of water, being under a low potential, will therefore tend to move in toward the center of the mass where the potential, *i. e.*, the total attraction, is greater, and the surface will tend to contract so as to leave the fewest possible number of particles on the surface.

If instead of air there is a solid substance in contact with the water the potential will be greater than on an exposed surface of the liquid, for the much greater number of solid particles will have a greater attraction for the water particle than the air particles had. They may have so great an attraction that the liquid particle on this surface, separating the solid and liquid, may be under greater potential than prevails in the interior of the liquid mass. Then the surface will tend to expand as much as possible, for the particles in the interior of the mass of liquid will try to get out onto the surface. This is the reverse of surface tension. It is surface pressure which may exist on a surface separating a solid and liquid.

If two small grains of clay suspended in water come close together they may be attracted to each other or not, according to the potential of the water particles on the surface of the clay. If the potential of the surface particle of water is less than of a particle in the interior of the mass of liquid, there will be surface tension, and the two grains will come together and be held with some force, as their close contact will diminish the number of surface particles in the liquid. If on the other hand the potential of the particle on the surface of the liquid is greater than the potential of a particle in the interior of the liquid mass, the surface will tend to enlarge, and

the grains of clay will not come close together, as their close contact will diminish the number of surface particles in the liquid around them.

The volume of empty space in soils (pp. 259–261).—"There is on the average about 50 per cent by volume of empty space in the soil. The amount in the soil proper will vary with the stage and state of cultivation, but the empty space in the undisturbed subsoil will remain fairly constant."

Determinations of the amount of space in Maryland soils were not made by the author, but he gives the per cent by volume of space in a number of South Carolina subsoils, as determined by him in their natural positions in the field. Of these, the six sandy subsoils averaged 45.43 per cent of space and the nine clay subsoils 55.55 per cent.

The relation of geology to agriculture (pp. 261–264).—General statements regarding the geological formations in Maryland, bringing out the fact that "the texture or the relative amount of sand and clay contained in the soil resulting from the disintegration of rocks will depend upon the kind of rock, that is, upon the minerals of which it is composed."

A thorough and detailed geological map of the State should answer for a soil map. Any one familiar with the texture of the soil, or kind of soil formed by the disintegration of granite, gabbro, and the different kinds of limestones, sandstones, and shales, should be able to tell by a glance at the map the position and area of each kind of soil. Each color on the map would represent a soil formation of a certain texture, in which the conditions of moisture under our prevailing climatic conditions would be best adapted to a certain crop.

Soil types (pp. 264–276).—For the purpose of determining the general characteristics of the soils of the State as indicated by their origin and agricultural value, a large number of samples of soils and subsoils were collected in different parts of Maryland.

These samples have been arranged in groups according to their agricultural value and their geological origin, and equal weights of the samples in each group have been mixed together, forming a composite sample representing the *type* of the soil formation. We have in this way classified the soils of all the principal agricultural regions of the State, and they are represented by comparatively very few type samples, as shown in the following table, in which the formations are not given in the order of their geological origin but according to their agricultural importance and distribution.

Soil types.

Sample No.	Agricultural use.	No. of localities.	Geological formation.
276	Pine barrens	*2	La Fayette.
283–4	Market truck	6–8	Eocene.
285–6	Tobacco	9–9	Neocene.
279–80	Wheat	7–14	Neocene.
277–8	Wheat soil of river terraces	5–5	Columbian terrace.
....	Barren clay hills	....	Potomac.
....	Grass and wheat	....	Trenton chazy limestone.
287–8	......do	2–4	Helderberg limestone.
238	......do	1	Catskill.
281–2	......do	4–5	Triassic red sandstone.
290	Mountain pasture	3	Oriskany.
289	Poor mountain pasture	6	Chemung, Hamilton, Niagara, Clinton.

*Where a double number is given the first number refers to the sample of soil and the second number to the subsoil. Where a single number is given for a type there is no perceptible difference between the soil and subsoil in the localities visited.

Details are given regarding the location, texture, and agricultural value of these types of soil. There are also descriptions of the individual samples of soils and subsoils used to make up the type samples.

Mechanical analysis of the type soils (pp. 276, 277).—The grains in the type soils of different kinds were divided into groups by size and the approximate number of grains in a given amount of each group was calculated. "The separations were made substantially after Johnson and Osborn's 'beaker method.' We have taken 0.0001 mm. as the lowest limit of size of the grains of clay, based on many measurements we have made. The clay group has relatively wide limits (0.005–0.0001 mm.), but we have not attempted a further separation than this. A millimeter is equivalent to about one twenty-fifth of an inch, so that the smallest grains of clay are about $\frac{1}{254000}$ or 0.0000039 inch in diameter."

The results of analyses of subsoils of the five formations in southern Maryland are given in the following table:

Mechanical analysis of type subsoils.

Diameter (mm).	Conventional names.	276. Pine barrens.	284. Truck.	286. Tobacco.	290. Oriskany.	280. Wheat.	278. River terrace.	282. Triassic.	238. Catskill.	289. Shales.	288. Helderberg limestone.
2–1	Gravel	4.87*	0.68	1.36	0.64	0.0	1.60	0.00	0.00	0.05	1.34†
1–0.5	Coarse sand	9.15	2.89	2.13	0.81	0.42	1.51	0.23	0.11	0.16	0.33
0.5–0.25	Medium sand	38.37	21.85	7.78	3.50	1.81	4.15	1.29	0.42	0.80	1.08
0.25–0.1	Fine sand	33.28	25.82	16.57	23.97	8.59	4.84	4.03	2.63	2.01	1.02
0.1–0.05	Very fine sand	3.52	18.38	19.83	34.76	32.06	8.54	11.57	11.35	6.70	6.94
0.05–0.01	Silt	3.47	9.48	25.41	10.03	23.65	44.92	38.97	40.23	31.63	29.05
0.01–0.005	Fine silt	1.55	3.37	4.52	3.03	6.77	5.78	8.84	10.90	14.24	11.03
0.005–0.0001	Clay	3.75	15.30	17.95	20.30	22.85	25.85	32.70	33.32	39.36	43.44
		97.96	97.77	95.55	97.04	95.85	97.19	97.63	98.96	94.91	94.23
Organic matter, water, loss		2.04	2.23	4.45	2.96	4.15	2.81	2.37	1.04	5.09	5.77

* This includes 1.81 per cent coarser than 2 mm.
† This includes 0.82 per cent coarser than 2 mm.

Approximate number of grains per gram of soil (pp. 277–280).—From the results in the foregoing table the approximate number of grains of sand and clay in one gram of the subsoils was calculated. It was found that the number of grains in the silt and clay groups so far exceeded those in the other groups combined that "they, and especially the clay, actually determine the extent of subdivision of empty space in the soil."

Approximate number of grains in one gram of subsoil.

276. Pine barrens	1,692,000,000
284. Truck	6,868,000,000
286. Tobacco	8,258,000,000
290. Oriskany	9,154,000,000
280. Wheat	10,358,000,000
278. River terrace	11,684,000,000

282.	Triassic red sandstone	14, 736, 000, 000
238.	Catskill	14, 839, 000, 000
289.	Shales (Hamilton, etc.)	18, 295, 000, 000
288.	Helderberg limestone	19, 638, 000, 000
....	Trenton chazy limestone	24, 653, 000, 000

From the mechanical analysis of the samples which were used to make up these type samples and perhaps of a large number of other soils of known agricultural value, it should be possible to determine the smallest and the largest number of grains per gram of soil where these different crops could be successfully grown. For example, no crop can be successfully grown except under highly artificial conditions of manuring with organic matter or by irrigation, on a soil having so few as 1,700,000,000 grains per gram. Good market truck is grown on a soil having 6,800,000,000 grains. Now what is the limit between these two figures where the soil becomes too light for market truck? Good wheat is grown on a soil having 10,000,000,000 grains per gram, and this must be near the limit of profitable wheat production, for 8,000,000,000 grains per gram gives a soil rather too light for wheat, but well suited to tobacco. A soil having 10,000,000,000 grains per gram is too light for grass, which thrives on a limestone soil having 24,000,000,000. Our type soils should therefore show the range for the profitable production of a given crop. We should be able also from the mechanical analysis of an unknown soil to give it its true agricultural place by reference to these established soil types.

Approximate extent of surface area per cubic foot of soil (pp. 280–282).—Tabulated data are given of the surface area of the grains of different degrees of fineness in the type soils. The square feet of surface per cubic foot of subsoil and the estimated percentages of empty space are stated to be as follows:

Surface area of different subsoils per cubic foot.

No.	Soil type.	Empty space.	Surface area per cubic foot.
		Per cent.	*Square feet.*
276	Pine barrens	40	23,940
284	Truck	45	74,130
286	Tobacco	50	84,850
290	Oriskany	50	87,720
280	Wheat	55	94,540
278	River terrace	55	106,200
282	Triassic	55	127,000
288	Helderberg limestone	65	129,700
238	Catskill	55	133,300
289	Shales (Hamilton, etc.)	60	142,700

The circulation of water in these type soils (pp. 282–286).

From the foregoing results we have calculated the relative rate with which a given quantity of water would pass through an equal depth of these subsoils under a constant force, taking the subsoil of the Helderberg limestone as a basis of comparison.

It would appear from results given below that with 12 per cent of water present in all the subsoils it will take only eight minutes for a quantity of water to pass through the subsoil of the pine barrens which would require one hundred minutes to pass through the same depth of the subsoil of the Helderberg limestone. It will pass through the subsoil of the wheat land of the river terraces in southern Maryland in about forty-nine minutes. It will move down more readily in these lighter soils from its own weight, but a given quantity of water could not be raised so readily to supply the needs of a growing crop, for there would be less exposed water surface to contract, that is, there would be less force to pull it up.

Rate of circulation of water in the type soils.

No.	Type of soil.	Per cent of space.	Relative time.*	Per cent of water.†	Relative time.	Per cent of water.‡	Relative time.
276	Pine barrens	40	8	5.3	101	20.10	74
284	Truck	45	21	7.2	101	22.41	141
286	Tobacco	50	33	8.4	102	27.42	121
290	Oriskany	50	35	8.6	101	27.42	130
280	Wheat	55	45	9.4	100	31.55	109
278	River terrace	55	49	9.6	100	31.55	119
282	Triassic	55	56	10.0	101	31.55	137
238	Catskill	55	58	10.1	100	31.55	140
289	Shales	60	81	11.2	100	36.14	123
288	Helderberg limestone	65	100	12.0	100	41.22	100

*Based on a uniform water content of 12 per cent.
†Amount of water which should be present in the subsoil for the rate of movement to be the same as in the Helderberg limestone with 12 per cent of water.
‡If all the space within the soils was filled with water.

It will be seen that the amount of space assigned to these different soil formations has an important bearing on the relative rate with which water will move within the different soils. The coarser-textured soils have less space and will contain less water than the clay soils. The subsoil of the truck land has only 45 per cent of space and will hold but 22.41 per cent by weight of water when this space is completely filled. The subsoil of the Helderberg limestone has 65 per cent of space and will hold 41.22 per cent by weight of water, or nearly twice as much as the truck land. When the soils contained only 12 per cent of water a quantity of water would move through the truck land in twenty-one minutes, which would require one hundred minutes to pass through the subsoil of the Helderberg limestone. When, however, these soils are taxed to their utmost it will take one hundred and forty-one minutes for a quantity of water to pass through the truck land, which would go through the limestone subsoil in one hundred minutes. As suggested in a previous section, this undoubtedly explains a matter of common observation and experience, that crops on these light lands are more injured by excessively wet seasons than crops on heavier soils.

The improvement of soils (pp. 286–296).—The amount of water in a soil and its rate of circulation being among the most important factors in determining the growth of cultivated plants, it follows that the art of cultivation and manuring must be based on the possible control of the water supply within the soil.

It has been shown how the relative rate of circulation of water may be calculated from the mechanical analysis of the soil. If this calculated rate could be compared with the actual rate of circulation in the soil in the field it would indicate the relative arrangement of the soil grains, so that if we had such a method there would be no such necessity for studying the symptoms of the plant to tell in what direction and how far the conditions in a soil have departed from the typical conditions required by a given crop or natural to the soil formation.

If the rate of circulation of water within the soil is shown, by actual observation or by its effect upon plants, to be slower than the rate calculated from the mechanical analysis and slower than the rate of circulation in the typical soil for that crop, the texture of the soil may be changed by changing the arrangement of the soil grains. The smallest grains may be drawn closer to the larger ones, making some of the spaces larger and others exceedingly small. Lime, kainit, and phosphoric acid seem to have this effect, as their continued use makes the soil more loamy, looser in texture, and less retentive of moisture.

Many of our agricultural lands need improvement in the other direction—they need to be made closer in texture and more retentive of moisture. We have found that

ammonia, the caustic alkalies, carbonate of soda, and probably many other substances (possibly organic substances in general) tend to prevent this flocculation and to push the smaller grains further apart, making the spaces within the soil of a more uniform size and thus retarding the rate of circulation of the soil moisture. We can not say what practical value this will have in its application to agriculture until more work has been done.

When a solution of organic matter comes in contact with lime, kainit, acid phosphate, and with certain soils, the organic matter is precipitated from solution in light, bulky masses, and these masses may fill up the spaces within the soil with solid matter which not only retards the rate of circulation of water downward by gravity, but by increasing the extent of water surface within the soil it also assists in pulling water up from below.

If so much organic matter is added to the soil that it can not be curdled or precipitated from solution, it may be injurious in the soil by reducing the surface tension of the soil moisture—the force which draws the water to the plant as needed. The judicious use of lime, kainit, or acid phosphate, along with the organic matter, will insure the precipitation of the organic matter from the solution and thus give a value to the application which it would not otherwise have had.

This gives a value to stable manure out of all proportion to the amount of plant food which it contains. Lime also, either alone or when acting with organic matter, has a distinct value for all classes of land. The nitrogenous matter in the stable manure and in other organic matters would determine the value as a fertilizer, for it is only the nitrogenous compounds which are so easily precipitated from solution by the mineral matters of the soil and of fertilizers. If the carbohydrates, such as starch, sugar, and woody fiber, could be as readily precipitated from solution in light, bulky masses by lime and the mineral matters of the soil, then sawdust or other organic refuse containing little nitrogen would have nearly the same fertilizing value as the more expensive nitrogenous materials.

The whole history of plat experiments shows that it is not the plant which is to be manured for, but the soil conditions must be changed to produce the plant.

Relation of geology and the chemistry of soils to agriculture, J. D. CONLEY (*Wyoming Sta. Bul. No. 6, May, 1892, pp. 3–12*).—A brief popular discussion of this subject.

Analyses of the soils of Wyoming Station farms, E. E. SLOSSON (*Wyoming Sta. Bul. No. 6, May, 1892, pp. 13–21*).—Tabulated mechanical and chemical analyses of the soils of the station farms at Laramie, Lander, Saratoga, Sheridan, Sundance, and Wheatland. A number of these analyses are given in the following table:

Analyses of soils of Wyoming Station farms.

	Laramie.		Lander.				Saratoga.	
	7 N. W.* surface. 1–9 in.	9 N. W.* subsoil. 9–18 in.	37 E.* surface. 1–9 in.	35 E.* subsoil. 9–18 in.	51 W.* surface. 1–9 in.	57 W.* subsoil. 9–18 in.	43 S. W.* surface. 1–9 in.	45 S. W.* subsoil. 9–18 in.
	Per cent	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Gravel (greater than 2 mm. diameter)	6.6	4.7	1.3	0.9	7.5	4.4	3.5	11.1
Coarse sand (1 to 2 mm. diameter)	1.9	1.6	0.7	0.9	0.0	0.1	5.0	4.3
Fine earth (less than 1 mm. diameter)	91.5	93.7	98.0	98.2	92.5	95.5	91.5	84.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ANALYSIS OF FINE EARTH.								
Insoluble matter	81.61	77.28	79.43	79.30	69.89	61.31	80.35	74.02
Soluble silica	2.62	1.92	2.98	3.26	1.19	1.60	1.16	1.01
Potash (K_2O)	0.64	0.53	0.68	0.77	0.61	0.56	0.73	0.18
Soda (Na_2O)	0.74	0.45	0.38	0.52	0.11	0.18	0.10	0.19
Lime (CaO)	0.82	3.77	0.64	0.52	6.63	12.39	0.74	8.10
Magnesia (MgO)	0.76	0.08	1.36	1.14	1.65	2.09	1.15	1.00
Iron (Fe_2O_3)	2.84	2.49	1.60	3.18	3.36	2.91	2.75	1.68
Alumina (Al_2O_3)	4.50	4.71	2.29	5.16	5.08	4.04	5.40	3.31
Phosphoric acid (P_2O_5)	0.14	0.15	0.15	0.17	0.20	0.18	0.13	0.21
Sulphuric acid (SO_3)	....	0.07	0.11	0.04	0.10	0.11	0.10	0.09
Carbonic acid (CO_2)	0.33	3.70	....	....	4.77	8.59	0.45	5.72
Moisture	1.87	1.24	2.07	1.82	1.48	1.33	2.08	1.47
Volatile and combustible matter	2.48	2.82	7.74	3.46	4.70	4.39	4.07	2.68
	99.35	99.21	99.43	99.34	99.77	99.68	99.21	99.66
Soluble in water	0.0589	0.0464	0.4148	0.0496	0.105	0.1724	0.1755	0.0534
Chlorine	0.0001	0.0001	0.0092	0.0005	0.001	0.0002	0.0056	0.0001
Humus	0.2500	0.1600	0.4300	0.3500	0.580	0.0900	0.2500	0.1300
Ash	0.5000	0.2800	0.2000	0.1400	0.420	0.1200	0.2600	0.1300
Capacity to hold water	45.6000	44.0000	44.6000	46.0000	40.600	44.6000	44.2000	41.0000

	Sheridan.			Sundance.		Wheatland.	
	33 S.* surface. 1–9 in.	31 S.* subsoil. 9–18 in.	55 S.W.* subsoil. Gumbo.	27 S.* surface. 1–9 in.	29 S.* subsoil. 14–20 in.	21* surface. 1–9 in.	23* subsoil. 9–18 in.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Gravel (greater than 2 mm. diameter)	0.0	0.0	0.0	....	....	0.9	0.6
Coarse sand (1 to 2 mm. diameter)	0.0	0.0	0.0	....	....	0.8	0.4
Fine earth (less than 1 mm. diameter)	100.0	100.0	100.0	100.0	100.0	98.3	99.0
	....	....	....	....	....	100.0	100.0
ANALYSIS OF FINE EARTH.							
Insoluble matter	81.72	78.15	65.33	68.49	77.61	77.92	72.18
Soluble silica	1.57	1.89	1.28	0.98	1.32	3.52	1.36
Potash (K_2O)	0.52	0.32	0.87	0.68	0.58	0.63	0.41
Soda (Na_2O)	0.20	0.43	0.25	0.90	0.40	0.34	0.34
Lime (CaO)	0.69	0.87	1.52	4.97	1.47	0.87	5.29
Magnesia (MgO)	0.94	1.22	3.29	3.21	1.75	0.85	1.29
Iron (Fe_2O_3)	2.98	3.71	4.47	3.40	3.09	3.52	2.94
Alumina (Al_2O_3)	5.83	6.29	11.20	5.42	5.52	6.88	5.09
Phosphoric acid (P_2O_5)	0.28	0.29	0.16	0.18	0.17	0.14	0.15
Sulphuric acid (SO_3)	0.14	0.20	0.28	0.18	0.19	0.08	0.08
Carbonic acid (CO_2)	....	....	1.19	6.53	0.54	0.88	5.39
Moisture	1.73	2.44	4.02	1.88	2.18	1.62	1.80
Volatile and combustible matter	3.81	3.36	6.48	3.60	4.40	3.62	3.04
	100.41	99.17	100.34	100.32	99.32	100.87	99.36
Soluble in water	0.0498	0.2433	0.2150	0.0505	0.0574	0.1726	0.0427
Chlorine	0.0001	0.0001	0.0002	0.0000	0.0001	0.0007	0.0000
Humus	0.2300	0.2200	0.4900	0.1600	0.7600	0.2100	0.1500
Ash	0.2100	0.3700	0.4800	0.1700	0.7800	0.2300	0.1400
Capacity to hold water	42.0000	41.4000	66.8000	43.0000	46.8000	46.6000	42.8000

* Station number and location of sample on farm.

Laramie.—The color of the soil is gray with a yellowish tinge, darker toward the northwest corner of the farm. The sand, both fine and coarse, is the same as that which forms the sandstone underlying the farm. The gravel consists of quartz and feldspar very slightly worn.

Lander.—The color of the dry soil is a dark reddish brown, lighter in the western part of the farm. The gravel in the eastern part consists of sandstone, white or stained red with iron; in the western part, of rough limestone fragments. The chemical analysis shows a great difference between the two parts of the farm, since the western contains 10 to 20 per cent of limestone, while it is almost entirely lacking in the other. Otherwise the soils are much alike, and it will be interesting to learn what effect this difference will have on crops.

Saratoga.—The soil is very much like that of the Laramie farm, but has a little more lime. The color is yellowish gray. The gravel consists of granitic fragments like the Laramie, but more worn and with varied colors. The plant foods, lime, potash, and phosphoric acid, are quite abundant. There is very little difference in composition between the northwest and southwest quarters.

Sheridan.—The soil is nearly black and all passes easily through the 1 mm. sieve. No. 55 is the so-called "Gumbo," from the southwest corner of the farm, a bluish black clay forming very hard lumps when dried. The capacity to hold water and the high percentage of alumina and potash show it to be of quite a different character from the other soils mentioned in this bulletin. There is some "alkali" soil in the northeast corner of the Sheridan farm, but it was not analyzed.

Sundance.—The soils are quite peculiar in appearance. The soil No. 27 is a bright, reddish brown to a depth of 12 to 14 inches, where it abruptly changes in color to black (No. 29), which continues to a depth of 38 inches. The chemical analysis shows little difference, except less lime and magnesia and more humus in the latter.

Wheatland.—No. 21 is a light brown soil; No. 23 is yellowish gray. The gravel consists of well-worn quartz and feldspar. The surface soil contains more clay and the subsoil more lime. Both form hard lumps when moistened and dried.

FERTILIZERS.

W. H. BEAL, *Editor.*

Fertilizer inspection in New Jersey (*New Jersey Report for 1891, pp. 5–85*).—This includes statistics as to the quantity and the value of the fertilizers sold in the State in 1891; the average retail prices of fertilizing ingredients for each year since 1882; the market prices of fertilizers; a comparison between the average wholesale and retail prices of fertilizing materials; remarks on the sources of nitrogen, phosphoric acid, and potash; the trade values of fertilizing ingredients for 1891; a popular discussion on home mixtures; methods employed in the inspection of fertilizers; and analyses of 329 samples of commercial fertilizers collected in 1891, including nitrate of soda, ammonia sulphate, ground fish, dried blood, cotton-seed meal, bone, boneblack, bone ash, South Carolina rock and other mineral phosphates, muriate of potash, sulphate of potash, potash-magnesium sulphate, kainit, tobacco stems, tobacco and sulphur, gas lime, fish scrap, hen manure, hair manure, odorless phosphate, refuse from phosphorus works, and double superphosphates. A circular was mailed to 94 firms dealing in

commercial fertilizers, asking for statistics of the amount of fertilizer sold during the year. Replies were received from 54 of these firms, which indicated a total consumption of fertilizers in New Jersey for 1891 of at least 43,414 tons. "These 54 firms represented the great bulk of the fertilizers sold in the State, the manufacturers who have not replied being as a rule those whose total output averages less than 50 tons per annum."

The total sales of fertilizers reported this year are greater than for any preceding year since 1882 except 1884, when 10,000 tons of poudrette were included. The complete fertilizers, 29,431 tons, indicate an expenditure this year of about $1,000,000, or 74 per cent of the total. This percentage is almost identical with that shown in previous years. In raw materials an increase is noticed in all cases except in bone-black, superphosphate, and ammonium sulphate. The amount of ground bone sold during last year is nearly double that sold in 1890.

A slight increase in price is noticed for all raw materials except boneblack.

Ground bone is somewhat lower than in any year since 1885, while the price of ammoniated superphosphates without potash is also lower than it had been for the last five years. The effect of this increase in price of raw materials has not been, however, to increase the price of complete fertilizers; the average price this year, $34.23 per ton, is lower than in any year since the station's establishment.

The statistics given indicate that "no decided change in the average quality of fertilizers has occurred during the past seven years * * * The decline in the prices of complete fertilizers from 1885 to 1891 was therefore not accompanied by a corresponding decline in the absolute amounts of plant food delivered to consumers." A calculation is made of the cost per pound of fertilizing ingredients in crude chemicals and raw materials. "An illustration of the importance of studying the relation which exists between the guaranties and selling prices is shown in the case of dried ground fish. This is a material of variable character, and though guaranties were reached in all the samples a difference of $7 per ton or 25 per cent existed between the highest and lowest selling prices, while the difference in the cost per pound of the nitrogen in the same samples was 6.2 cents, or 55 per cent."

[In the above report are incorporated Bulletins Nos. 81, 83, and 84 of the station (E. S. R., vol. III, pp. 168, 310, and 523).]

Fertilizer analyses and inspection in Massachusetts (*Massachusetts State Sta. Report for 1891, pp. 249–301*).—This includes a report on fertilizer inspection; analyses of wood ashes, cotton-hull ashes, cotton-seed meal, calcium sulphate, burnt lime, nitrate of soda, muriate of potash, sulphate of potash, Florida phosphatic rock, dissolved bone-black, superphosphate, bone, ground fish, tankage, fish chum, wool waste, cotton waste, tobacco leaves, saltpeter waste, waste from lactate factories, muck, peat, mud, marl, home-mixed fertilizers; and a compilation of analyses of agricultural chemicals and refuse materials used for fertilizing purposes.

Commercial fertilizers (pp. 250–279).—General remarks on commercial fertilizers and fertilizer inspection, schedule of trade values of

fertilizing ingredients for 1891, text of the Massachusetts fertilizer law, list of licensed dealers, and analyses of 146 samples of commercial fertilizers, including bone, dissolved boneblack, muriate of potash, sulphate of potash, sulphate of ammonia, nitrate of soda, and wood ashes. The methods used in the analysis of fertilizers are briefly described.

Analyses of marl, lime, etc., H. J. PATTERSON (*Maryland Sta. Report for 1891, pp. 297–346*).—Analyses and descriptions of the following materials: Marls (28 samples), lime, limestones, pulverized marble, and muck.

Field experiments, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1891, pp. 171–206*).—*Nitrogen experiments on rye* (pp. 172–179).—An experiment on 11 eighth-acre plats which previous experiments had shown to be deficient in potash. Several of the plats had received no nitrogenous fertilizers for five years. Eight hundred pounds of barnyard manure was used with 32 pounds of potash-magnesia sulphate and 18 pounds of dissolved boneblack on 1 plat, and on the others mixtures of 50 pounds of dissolved boneblack with 25 pounds of muriate of potash and with 48.5 pounds of potash-magnesia sulphate were applied alone and in connection with 29 pounds of sodium nitrate, 43 pounds of dried blood, and 22.5 pounds of ammonium sulphate, respectively. Rye was sown in drills on all the plats September 5, 1890, at the rate of 5.5 pounds of seed per plat. The results of measurements of the grain showing the rate of growth and the yield of grain, straw, and chaff, are tabulated for each plat. One plat was excluded on account of insect injuries and 1 plat suffered from winterkilling. No conclusions are drawn as to the effects of the different nitrogenous manures further than that "the belief in the beneficial influence of a liberal supply of nitrogen on the quantity and quality of grain crops is evidently well sustained by the results of the above-described experiment."

Special phosphoric acid experiments (pp. 200–206).—The plats which were used in 1890 for an experiment with potatoes, described in the Annual Report of the station for 1890, pp. 187–191 (E. S. R., vol. III, p. 159), were sown to wheat after the potato crop had been removed, the same fertilizers being applied as in the case of the potatoes, except that the plat which previously had received apatite received no further additions of phosphoric acid. Notes are given on the growth of wheat on different plats, including measurements, and the final yields of grain, straw, and chaff are tabulated. The largest yields of threshed grain were with South Carolina phosphate and with Mona guano. The largest yield of grain and straw was with dissolved boneblack, "due in an exceptional degree to the large production of straw and chaff."

Coöperative field experiments with fertilizers, C. S. PHELPS (*Connecticut Storrs Sta. Report for 1891, pp. 173–197*).—These included soil tests and special corn experiments.

Soil test experiments (pp. 176–185).—Reports are detailed of six experiments on private farms, four being with corn and two with potatoes.

Nitrate of soda 160 pounds, muriate of potash 160 pounds, and dissolved boneblack 320 pounds were used two by two and all three together; and plaster 400 pounds was used alone on 1 plat. In addition to the tabulated yields are given the percentages of dry matter in the corn and the number of pounds of each required for a bushel of shelled corn. In several instances the results furnished more or less conclusive indications of the special needs of the soil for the crop grown.

Special corn experiments (pp. 186–197).—"This class of experiments was planned for the purpose of studying the best proportions of phosphoric acid and potash for use in growing corn on soils whose peculiarities had already been studied by means of soil tests." Consequently the nitrogen supply was constant for all the manured plats, and dissolved boneblack and muriate of potash were applied in varying amounts. There were three experiments on 10 or 11 plats. The yields and financial results are tabulated. These are different for different trials, and no general conclusions are drawn as to the best combination of fertilizers for corn.

FIELD CROPS.

A. C. TRUE, *Editor.*

Special nitrogen experiment on grass, C. D. WOODS and C. S. PHELPS (*Connecticut Storrs Sta. Report for 1891, pp. 29–40*).

Synopsis.—Mixed minerals alone or combined with nitrate of soda or ammonium sulphate in different amounts, were applied to a mixture of grasses and clover. The most profitable returns were with 320 pounds per acre of nitrate of soda combined with mixed minerals. Minerals alone were unprofitable. Nitrogenous fertilizers increased the protein in the grasses.

The special nitrogen experiments on grass reported in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 376) were continued in 1891 without change. As there explained, the general plan was to combine nitrogen with mixed minerals, furnishing the former as nitrate of soda and as ammonium sulphate in amounts equivalent to 25, 50, and 75 pounds of nitrogen per acre, respectively. The grasses growing on the field are principally timothy, redtop, and Kentucky blue grass, with a slight admixture of clover and some weeds. The grass was cut for hay June 29. The yields of hay and of separate food ingredients, the composition of the hay grown with different fertilizers, and the financial results are tabulated for 1890 and 1891.

The addition of mineral fertilizers in 1890 increased the yield of clover very markedly, and somewhat so in 1891, but did not seem to increase very decidedly the yield of grass.

The yield of hay in 1890 increased with the quantity of nitrogen supplied, whether it was applied in the form of nitrate of soda or sulphate of ammonia. In 1891 the largest yield was obtained from the plat on which nitrate of soda was applied at the rate of 50 pounds per acre.

The mineral fertilizers in both years when used alone were applied at a financial loss.

The best financial returns, a gain of $5 per acre, were obtained in both seasons from the use per acre of 320 pounds of nitrate of soda (50 pounds of nitrogen) in addition to the mixed minerals. The drouth in the early part of June made the season of 1891 an unfavorable one for fertilizer experiments on grasses.

The application of nitrogenous fertilizers increased the percentages of protein (nitrogen multiplied by 6.25) in the grasses, and somewhat in proportion to the amounts applied. This is in accord with observations made by the station upon the relation of the protein in maize, corn, and clover to the nitrogen applied in the fertilizers. Since protein, which makes blood, bone, muscle, and milk, is a most important ingredient of food and is apt to be deficient in our feeding stuffs, this increase of protein from the use of nitrogen is an important matter.

The increase in the amount of nitrogen in the crop did not equal the increased amount of nitrogen supplied in the fertilizers, implying that the plants were not able to avail themselves of all the nitrogen supplied.

Forage crops, C. S. PHELPS (*Connecticut Storrs Sta. Report for 1891, pp. 9-13*).—Brief accounts of the culture of the following crops which have been grown at the station for use in soiling experiments with milch cows: Wheat, clover and grass, oats and peas, oats and vetch, Hungarian grass, cowpeas, and barley and peas. As the result of three years' experience and observation the author recommends the following series of crops for soiling purposes in central Connecticut:

Crops for soiling in central Connecticut.

Kind of fodder.	Amount of seed per acre.	Approximate time of seeding.	Approximate time of feeding.
1. Rye fodder........bushels	2½ to 3	Sept. 1	May 10-20.
2. Wheat fodder........do	2½ to 3	Sept. 5-10	May 20-June 5.
3. Clover........pounds	20	July 20-30	June 5-15.
4. Grass (from grass lands)			June 15-25.
5. Oats and peas (each)........bushels	2	April 10	June 25-July 10.
6. Oats and peas (each)........do	2	April 20	July 10-20
7. Oats and peas (each)........do	2	April 30	July 20-Aug. 1.
8. Hungarian........bushels	1½	June 1	Aug. 1-10.
9. Clover rowen (from 3)			Aug. 10-20.
10. Soja beans........bushels	1	May 25	Aug. 20-Sept. 5.
11. Cowpeas........do	1	June 5-10	Sept. 5-20.
12. Rowen grass (from grass lands)			Sept. 20-30.
13. Barley and peas (each)........bushels	2	Aug. 5-10	Oct. 1-30.

Scarlet clover (*New Jersey Sta. Report for 1891, pp. 143, 144*).—To test the adaptability of this plant to the conditions of agriculture in New Jersey, seed was sent to eight farmers in seven of the central and northern counties of the State. No report is yet given of the result of the tests.

A late crop of Irish potatoes in the South, W. F. MASSEY (*North Carolina Sta. Bul. No. 85, Apr. 26, 1892, pp. 9*).—The author calls attention to the fact that whereas twenty-five years ago it was the common practice in the South to plant in July Irish potatoes kept over from the previous year, it is now becoming customary to use potatoes of the early crop of the same year as seed for the late crop. He gives the following advice regarding the culture of this second crop:

(1) Bed the seed in soil until planting time. This gets rid of those too immature to grow and which if planted would leave gaps in the rows.

(2) Plant about second week in August if possible and use only those potatoes that are sprouted.

(3) Plant in a deep furrow, but cover very lightly and pack the soil to the seed.

(4) Never cut the potatoes for the late crop.

(5) Gradually fill in the soil to the plants as they grow and cultivate the crop perfectly flat.

It has been found that these late potatoes are particularly easy to keep either in barrels or crates in buildings, or out of doors in heaps covered with earth and fine straw or cornstalks.

Answers to a circular of inquiry regarding this second crop of potatoes are summarized. The variety preferred by most growers is the Early Rose. The importance of growing a second crop of potatoes for marketing in the South is urged.

Experiments with fertilizers on potatoes, E. B. VOORHEES (*New Jersey Sta. Report for 1891, pp. 108–123*).—A reprint from Special Bulletin P of the station (E. S. R., vol. III, p. 881), to which are added the analyses of the potatoes grown in the experiments with different fertilizers.

Experiments with potatoes, E. S. RICHMAN (*Utah Sta. Bul. No. 14, June 1, 1892, pp. 2–7*).—In an experiment in which whole tubers, halves, quarters, and one-eye and two-eye cuttings were planted, the yield increased with the amount of seed used, but it is doubtful whether pieces larger than quarters "will yield enough more to pay for the extra amount of seed required." Pieces cut from the stem end of potatoes gave larger yields than those cut from the seed end. Experiments with large and small potatoes for seed during two years have given inconclusive results. Flat culture of potatoes gave better results than ridge culture. The yields of 14 of the newer varieties are given. The most promising varieties were Hoffman, Governor Rusk, and Rural New Yorker No. 2.

Chemistry of the tobacco plant, R. J. DAVIDSON (*Virginia Sta. Bul. No. 14, March, 1892, pp. 19–26*).

Synopsis.—Analyses of the air-dried leaves, stalks, and roots, and of the ash of the same, of 4 varieties of tobacco. In average composition the leaves and stalks do not differ materially. About one third of the fertilizing ingredients are in the roots and stalks.

This is a preliminary report on the study of the tobacco plant, which it is expected will extend over a number of years. The present report covers 4 varieties. For these analyses are given of the air-dried leaves, stalks, and roots, and of the ash of the same, with averages; the relation of parts of the plant; and a calculation of the amounts of fertilizing ingredients contained in crops yielding 1,000 pounds of leaf tobacco per acre. The analyses of the air-dried parts of the plant are here given.

Analyses of parts of the tobacco plant.

	Moisture at 100° C.	Nitrogen.	Phosphoric acid.	Potassium oxide.	Calcium oxide.	Magnesium oxide.	Insoluble matter.
Leaf:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Bradley Broad Leaf	7.34	4.11	0.382	5.731	6.128	0.949	2.152
Gold Finder	8.09	4.30	0.371	5.643	5.067	0.913	2.254
White Burley	7.49	4.46	0.765	5.980	5.193	1.089	1.898
Yellow Oronoco	7.59	4.62	0.489	5.597	5.407	0.872	1.469
Average of varieties	7.62	4.37	0.502	5.738	5.449	0.956	1.943
Stalk:							
Bradley Broad Leaf	5.87	3.55	0.536	4.462	2.131	0.502	0.578
Gold Finder	6.01	3.58	0.518	4.922	2.191	0.568	0.491
White Burley	6.89	4.24	0.975	5.716	2.285	0.729	0.987
Yellow Oronoco	5.95	3.44	0.555	4.978	2.281	0.571	0.593
Average of varieties	6.18	3.71	0.646	5.020	2.222	0.593	0.662
Root:							
Bradley Broad Leaf	5.63	2.18	0.208	1.802	1.328	0.214	3.204
Gold Finder	6.14	1.65	0.144	1.410	1.115	0.144	1.663
White Burley	6.35	2.01	0.375	2.322	1.598	0.312	4.235
Yellow Oronoco	6.84	1.65	0.130	1.497	1.023	0.177	2.582
Hyco	6.15	1.93	0.196	1.856	1.312	0.186	2.703
Average of varieties	6.25	1.88	0.211	1.777	1.277	0.208	2.877

In average composition the leaves and stalks do not differ materially except in nitrogen, the leaves containing about two thirds per cent more than the stalks. The table of relation of parts of the plant shows the Bradley and Oronoco to contain much the largest proportion of leaf. In these varieties the leaves comprise 59.77 and 60 per cent, respectively, of the total weight of the plant, and the stalks 21 and 20 per cent. The average for all 4 varieties is 55 per cent of leaf, 21.9 of stalk, and 23.1 per cent of root. A crop yielding 1,000 pounds of leaves is calculated to contain on the average 66.85 pounds of nitrogen, 8.68 pounds of phosphoric acid, and 85.41 pounds of potash, distributed as follows:

	In leaves.	In stalks.	In roots.
	Pounds.	*Pounds.*	*Pounds.*
Nitrogen	43.7	15.2	7.9
Phosphoric acid	5.0	2.7	1.0
Potassium oxide	57.4	20.5	7.5

It will be seen that about one third of the fertilizing ingredients are in the roots and stalks, which should be returned to the soil.

A comparison is made between the amounts of fertilizing ingredients contained in crops of tobacco, corn, oats, and wheat.

Fertilizers on tobacco (*Virginia Sta. Bul. No. 12, Jan., 1892, pp. 7*).

Synopsis:—Potassium sulphate and acid phosphate, combined with ammonium sulphate, nitrate of soda, or dried blood, were compared with no manure for tobacco on a "typical yellow tobacco soil." The fertilizers hastened the maturing of the crop and largely lessened the amount of stalk rot. Dried blood was the most effective and profitable form of nitrogen used.

Tests were made in 1890 on 6 one-acre plats manured as follows: Potassium sulphate 120 pounds and acid phosphate 114 pounds were

used in combination with ammonium sulphate 100 pounds, nitrate of soda 143 pounds, and dried blood 160 pounds, respectively, and with mixtures of half these amounts of ammonium sulphate, nitrate of soda, and dried blood, and 1 plat remained unmanured. The soil was a "typical yellow tobacco land, only one year from the forest, on which tobacco had been cultivated the preceding year." An analysis is given of the soil. Long Leaf Gooch tobacco was set 3½ feet by 3 feet May 28. Half the fertilizer for each plat was broadcasted and the remainder was drilled in. "The year 1890 was favorable to tobacco. Somewhat too much rain fell during the growing season, but the rains ceased in a measure after July, and the weather during August and September proved exceptionally favorable to the barning and curing of the crop. A full crop, over the average in quality, was in consequence obtained." The yields of graded tobacco are tabulated for each plat, together with the financial results of the test.

The tobacco on the unfertilized plat ripened from ten days to two weeks later than that grown on the manured plats, showing that fertilizers hasten the maturity of tobacco to that extent. * * *

Of the nitrogenous fertilizers used the dried blood gave the largest yield and also the largest financial returns. * * *

In weight and value the crop of plat No. 5 [ammonium sulphate] was the lowest of any of the fertilized plats. The tobacco on this plat suffered more from field fire than that on any of the others. This injured the yield and reduced its value. There was some field fire on plat No. 1, on which less sulphate of ammonia was used.

Dried blood gave good results on the 3 plats on which it was used, and where combined with nitrate of soda, in plat No. 2, the results were also good. * * *

Where dried blood and nitrate of soda were used in combination or separately there was scarcely any field fire—much less than where no fertilizers were applied.

There was also more stalk rot (called by some planters "hollow stalk") on the unmanured plat than on all the fertilized plats put together. This is suggestive. If verified by future tests it will point planters to the remedy.

To sum up, the results of the tests appear to indicate that nitrogen was most effective in the form of dried blood, and that the nitrogen of nitrate of soda was more available than that of sulphate of ammonia. Also, that fertilizers can be made to pay and pay well if compounded of materials suited to the tobacco crop and adapted to the thin siliceous soils of middle Virginia.

Tobacco-curing by the leaf cure on wire and the stalk processes, H. B. BATTLE, T. L. BLALOCK, and F. B. CARPENTER (*North Carolina Sta. Bul. No. 86, May 2, 1892, pp. 30*).

Synopsis.—The method of curing tobacco leaves on the stalk in an ordinary barn was compared with that of curing the leaves alone strung on wires in a "Snow modern barn." The tobacco used was a yellow variety, and was taken from two plats in the same field. For leaf-curing on wires the leaves were stripped from the stalk and cured at three different dates. This method was more expensive than the stalk cure, but the product was larger and of better quality, so that the net receipts for the cured tobacco were very much larger. When the leaves are stripped before curing the stalks can be left in the field and plowed under, thus saving their fertilizing ingredients.

A detailed account of a comparative test of methods of curing tobacco leaves with and without the stalks, prefaced by general statements regarding the culture of tobacco and descriptions of the leaf and stalk

processes of curing. The test was carried on at Oxford, North Carolina, under the direct supervision of the station. Great care was taken to make the test a fair and impartial one. The tobacco used was a yellow variety and was taken from 2 half-acre plats in the same field. "Before the test was instituted the whole field had already been primed at topping, and an average of two small leaves had already been removed from all the stalks and thrown away. It was claimed for the leaf-cure process, with some degree of justness, that these leaves could have been saved and cured, and the result would have been a clear gain for this side of the test." The number of stalks taken from each plat was 1,975. The leaf-curing was done by an expert in a "Snow modern barn" 3 miles from the tobacco field, the stalk-curing by an experienced laborer in an old-fashioned log barn about one third of a mile from the field. The temperature in the modern barn ranged from 75° to 156° F., in the log barn from 96° to 200°. For curing by the former method leaves were stripped from the stalks at three different dates. The number of hours required for curing the leaves was seventy-five, fifty-seven, and eighty-one, respectively. The details of the curing, amount and cost of labor, temperature in the barn at intervals during the curing, amount and value of tobacco of different grades produced, etc., are reported in notes and tables.

Cost of first priming and curing by leaf-cure method, August 17.

Priming.—4 men for 1¼ hours, at 6 cents per hour each	$0.32
Stringing.—2 men for 1¾ hours, at 6 cents per hour each	0.21
1 woman for 1¾ hours, at 3½ cents per hour	0.06
3 children for 1¾ hours, at 1½ cents per hour each	0.08
Tiering.—1 man for 1¾ hours for tiering, at 6 cents	0.11
Total	0.78

Cost of second priming and tiering by leaf-cure method, September 1.

Priming.—6 men for 1 hour, at 6 cents per hour each	$0.36
Carrying to wagons.—8 men 10 minutes, at 6 cents per hour each	0.08
Loading.—2 men 20 minutes, at 6 cents per hour each	0.04
Stringing.—3 children 2¼ hours, at 1½ cents per hour each	0.10
2 women 2¼ hours, at 3½ cents per hour each	0.16
3 boys 2¼ hours, at 5 cents per hour each	0.34
Tiering.—1 man 2¼ hours, at 6 cents per hour	0.14
Total	1.22

Cost of third priming and tiering by leaf-cure method, September 14.

Priming.—5 men for 45 minutes, at 6 cents per hour each	$0.23
Carrying to wagon.—5 men for 10 minutes, at 6 cents per hour each	0.05
Loading.—2 men for 10 minutes, at 6 cents per hour each	0.02
Stringing.—6 men for 75 minutes, at 6 cents per hour each	0.45
3 boys for 1¼ hours, at 5 cents per hour each	0.19
2 children for 1¼ hours, at 1½ cents per hour each	0.04
1 woman for 1¼, at 3½ cents per hour	0.04
Tiering.—2 men for 1¼ hours, at 6 cents per hour each	0.15
Total	1.17

Cost of cutting and tiering by stalk-cure method, September 15-18.

Cutting.—2 men for 1.56 hours, at 6 cents per hour each	$0.19
2 women for 1.56 hours, at 3½ cents per hour each	0.11
1 child for 1.56 hours, at 1¼ cents per hour	0.02
Loading.—First load, 4 men for 13 minutes, at 6 cents per hour each	0.05
Second load, 5 men for 9 minutes, at 6 cents per hour each	0.05
2 boys for 9 minutes, at 5 cents per hour each	0.02
Third load, 5 men for 8 minutes, at 6 cents per hour each	0.04
2 boys for 8 minutes, at 5 cents per hour each	0.01
Tiering.—5 men for 30 minutes, at 6 cents per hour each	0.15
	0.64

Cost and profit of leaf-curing vs. stalk-curing of 1,975 stalks.

	Leaf-curing.	Stalk-curing.
Priming	$0.91	
Cutting and hanging		$0.32
Loading	0.28	0.16
Hauling	1.80	0.45
Stringing on wires	1.66	
Tiering	0.39	0.15
Taking down and bulking	0.99	0.15
Time of curer	2.76	3.00
Wood consumed	0.80	1.16
Total cost	9.59	5.39
Gross receipts for cured tobacco	63.14	38.29
Net receipts for cured tobacco	53.56	32.90
	Pounds.	*Pounds.*
Weight of fresh leaves and stalk	2,109	2,114
Weight of cured leaves	454	326

Conclusions.—(1) If the first priming leaves upon the tobacco stalk be saved they can be cured at a considerable saving. The remaining leaves upon the stalk ripen at different times, commencing from below, and if these leaves be cured separately the experiment would indicate that it can be done advantageously and remuneratively. Curing by the leaf process the plant will require at least three separate curings in the barn, whereas only one curing is required to cure the entire stalk with its leaves still upon it, but the results justify the additional labor. It is believed also that by removing the lower leaves the remainder mature more rapidly, and so the danger of being hurt by frost is decreased.

(2) The manipulation in handling the leaves separately is considerably more than in the stalk cure, but the greater part of it is of such a nature that it can profitably be done by children and at various times during the season.

(3) There is a smaller consumption of wood for heating by the leaf cure than by the stalk cure. There is apparently no satisfactory cause for consuming wood to drive off the water contained in the green stalks when results would indicate that there is no good reason for the outlay.

(4) The station is not prepared to say that the stick with the wires, as used by the Modern Barn Company, for holding the leaves in curing, is better than any other plan, as no other device was used in comparison with it. The stick was handled conveniently, however, and did its work satisfactorily.

(5) The Snow barn, which was used in this test, is a great advance from the old style log barn. Scientific principles are consulted and the construction, as now conducted, is the best for the purpose of curing tobacco, more particularly in relation to the yellow type variety, that is known. The plans for securing thorough and rapid ventilation, and consequently for lowering or raising the temperature of the barn, are to be commended. With it tobacco-curing is more susceptible of

being converted into a science than was ever possible with the crude arrangements so generally adopted in the log barn. Experience will ever be required in tobacco-curing, but with the coming of improved fixtures and appliances failures in curing will be decreased and the consequent loss to the owner will be greatly diminished. And with these improvements the facility with which the methods can be transmitted and learned by beginners will always be appreciated by those who embark upon the culture of tobacco for the first time. The station is not prepared to indorse all the statements made by the Modern Barn Company, nor to state that the formula for curing in their barn is not susceptible of alteration and improvement. On the contrary, it is believed that the formula can be changed very materially to lessen many complications which appear to be unnecessary. In the three cures as carried on by a representative of the company the method was not followed in many particulars, and yet each of the three curings was considered a success. The time required in curing likewise is believed to be subject to variation and may be lessened materially.

(6) The curing as conducted in this experiment was made in the Snow barn on the Snow wire stick. As has been stated, the leaf-cure process may be conducted in a log barn, using the Snow wire stick or some similar device. It is believed that the very great increase of value by the leaf-cure process is due less to the barn appliances than to the method of curing the leaves separately as they ripen upon the stalk, though the improved barn no doubt was an important factor in bringing this about. As to what are the comparative merits of the leaf-curing on wire in the Snow barn and the leaf-curing on wire in an old style log barn, it is impossible now to say.

(7) The plan of plowing under tobacco stalks after the leaves have been removed by the leaf-curing process, as advised by the Snow process, is to be commended. It restores to the soil whatever fertilizing ingredients there may be in the stalk, and it prevents the growth of suckers from the stalk, which is considered wasteful and harmful to the soil, for these materials generally are left in the field during the winter to be scattered and destroyed. If after plowing the stalks under crimson clover (an annual) be sown, it will prevent the fields from washing and will attain a good growth by the spring, when it in turn can be plowed under to receive the next tobacco crop—a process which is of value as a permanent enricher of the soil, as the clover belongs to the family which has the power of absorbing and retaining in a large measure that most valuable and useful gaseous element of the air—nitrogen.

(8) The experiment, so far as has been told, relates to methods, weights, and values of the two parts of the acre. As to how the result recorded is brought about other than as described, what changes take place in the leaf in curing, what chemical compounds are formed which give the chief value of the leaf, and whether these compounds are formed more abundantly in the leaf by the leaf cure than by the stalk cure, must remain for another bulletin. Samples were carefully taken of all the grades produced in each process and these will be analyzed, both for their inorganic mineral ingredients and their organic compounds. This chemical work will be carefully done and the results promise to be of interest and value.

Experiments with wheat, A. I. HAYWARD (*Maryland Sta. Bul. No. 14, Sept., 1891, pp. 207–223*).

Synopsis.—These included (1) a test of varieties, (2) experiment with seed from Maryland and Kansas, and (3) a soil test with fertilizers. Previous accounts of similar experiments may be found in the Annual Reports for 1889 and 1890 and in Bulletin No. 10 of the station (E. S. R., vol. II, pp. 351 and 726, and III, p. 513).

Wheat, test of varieties (pp. 207–215).—Descriptive notes and tabulated data for 48 varieties. In 1891 the most productive varieties were,

Fultz, Golden Amber, Currell Prolific, Red May, Wyandotte Red, High Grade, Extra Early Oakley, Arnold Hybrid, Zimmerman, Fulcaster, and Strayer Egyptian.

Wheat from Maryland and Kansas seed (pp. 215, 216).—A brief account of an experiment with 6 varieties. There was no great difference in the results in favor of seed from either locality.

Wheat, methods of seeding and quality of seed (pp. 216–218).—Notes and tabulated data on an experiment in which sowing broadcast was compared with drilling, and seed of the best, medium, and poor quality was sown with a drill. The results were indecisive.

Wheat, soil test with fertilizers (pp. 218–223).—The land and the fertilizers used for this test were those employed in a similar experiment with corn in 1889 and 1890, as recorded in the Annual Reports of the station for those years (E. S. R., vol. II, p. 352, and III, p. 513). The variety grown was Golden Cross, which gave relatively small yields on all the plats. The results are tabulated. Nitrogen alone, in various forms, gave profitable returns. Lime materially increased the yield, but marl produced little effect. Potash and phosphoric acid, singly and in combination, were ineffective. Averaging the results with corn and wheat for the three years, it appears that phosphoric acid alone gave negative results, potash increased the yield 2 per cent, lime 22 per cent, and nitrogen alone 62 per cent.

Report of agriculturist of Maryland Station for 1891, A. I. HAYWARD (*Maryland Sta. Report for 1891, pp. 347–378*).

Synopsis.—This includes the following subjects: (1) Silos and silage, (2) crops grown for silage, (3) soil test with corn, (4) experiment in detasseling corn, (5 and 6) tests of varieties of oats and wheat, (7) grasses and forage plants, (8) rotation experiment, (9) potato experiments, (10) Maryland *vs.* Vermont potatoes for seed, and (11) miscellaneous.

Silos and silage (pp. 347–350).—Two of the station silos which were coated inside with creosote oil when constructed in 1888 have remained intact, while the lining boards of a third silo which were not thus coated were so far decayed in 1891 that it was deemed advisable to replace them with new boards. Silage made from a mixture of corn and soja beans decayed rapidly after the silo was opened, and corn silage made from the whole stalks did not prove to be an economical feeding stuff on account of a large percentage of waste. About 75 tons of corn silage were stored at the station in 1891 at an average expense of 75 cents per ton for harvesting, hauling, cutting, and storing.

Crops grown for silage (pp. 350–355).—Notes and tabulated data on the methods of planting and cultivation, yield of green and dry fodder, and percentages of water and ash at different stages of growth for corn, Jerusalem corn, Chinese sorghum, and corn with sorghum, cowpeas, or Jerusalem corn grown on 14 plats. Samples of the crop were weighed and analyzed at three stages of growth as follows: (1) The cob developed but the kernel unformed, (2) the kernel in the dough state,

and (3) the kernel hard and nearly ripe. In the first two stages the ratio of dry to green substance was practically the same, but there was an increase of 23 per cent in the production per acre. At the third stage the ratio of dry to green substance was 1: 3.6, but the total green forage per acre decreased 4.2 per cent as compared with the second stage. There was, however, a gain of 28.7 per cent of dry substance over that at the second stage. As regards yield of dry fodder, the results favored a distance of 2.5 feet between the rows rather than 3 or 3.5 feet when the stalks were 9 inches apart in the row. There was little difference in the yields from planting at 9, 12, and 6 inches apart in the row. Shallow cultivation (1 to 1.5 inches) as compared with medium (3 inches) and deep (5 inches) gave the largest yields with only about half the labor required by the other methods.

Soil test with corn (pp. 355–358).—Notes and tabulated data on an experiment on 23 tenth-acre plats of clayey loam soil with gravelly subsoil. The land was used for wheat in 1890 and had previously been cropped for a number of years with little or no manuring. The fertilizers used were stone lime, oyster shells (burned or ground), marl, land plaster, Thomas slag or Chile guano, sulphate of iron, kainit, castor pomace, and stable manure, each singly; boneblack, muriate of potash, and nitrate of soda, singly, two by two, and all three together; and South Carolina rock alone and in combination with nitrate of soda and muriate of potash or with dried blood and muriate of potash. The effects of the fertilizers were not clearly shown in the yield. Kainit and complete fertilizers gave the largest yields.

Experiments in detasseling corn (pp. 358, 359).—The tassels in two rows out of every three in a portion of the cornfield were removed. The results, as tabulated, show the largest average yields for the rows where the tassels were not removed.

Test of varieties of oats (pp. 359–361).—Forty-two different varieties were grown in 1891, but the crop was so poor that details of the test are not given. The largest yields were produced by Surprise, Barley, Early Arkangel, Unknown, Badger Queen, Canada White, Probsteier, and Virginia Winter.

The American Banner and American Beauty are doubtless the same variety under different names. Some authorities give the following as different names for the same variety: Badger Queen, Barley, Clydesdale, Prize Chester, Race Horse, Welcome, White Belgian, and White Canadian. Excepting the Barley, the Clydesdale from Thorburn, and the White Belgian, the other varieties appear on our grounds to be the same oats. But here we have the variety Clydesdale from two different seedsmen, with a week's difference in time of ripening, and showing different characters in the head. * * * The White Belgian if true to name should have a large open panicle or head; our White Belgian had a closed panicle, with the spikelets all dropping to one side, sometimes called side oats, and was undoubtedly identical with White Russian, Baltic White, and Japan. The Red Rust-Proof and Texas Rust-Proof are the same variety and the Black Prolific and Black Tartarian are indentical. * * * There was this year no appreciable difference between Early Arkangel, Improved White Russian, Harris, Improved Welcome, and Hargett Seizure, but a single year's trial will not warrant calling them all by one name.

Test of varieties of wheat (p. 361).—The details of this experiment are given in Bulletin No. 14 of the station (E. S. R., vol. IV, p. 35).

Grasses and forage plants (pp. 362–366).—Notes on a number of species which have been grown at the station. The following have given good results: Sweet vernal, orchard grass, tall oat grass, meadow foxtail, sheep's fescue, meadow fescue, tall fescue, Johnson grass, and Bermuda grass. Bermuda grass, timothy, and Johnson grass did not do as well in 1891 as formerly. Grasses of the fescue family seem especially well adapted to the region of the station. Crimson clover has been grown for several years past in various parts of the State, and generally with good results. Alfalfa has not been successfully grown at the station. Experiments with *Lathyrus sylvestris* are in progress. The Unknown pea, a variety of cowpea, produced a large amount of green forage and is recommended for purposes of green manure. Japanese clover grows in this region as a low and spreading plant, forming excellent pasturage, but only during a short season in the fall.

Rotation experiment (pp. 366–369).—A report of progress showing the yields of crops in 1891 on 6 plats laid out in 1888.

Potato experiments (pp. 369–374, figs. 2).—Notes and tabulated data for an experiment in which large and small whole potatoes, two or three-eye-pieces, and one-eye pieces were planted. The varieties used were Early Rose, New Queen, Dakota Red, and Early Harbinger. The results of this and of two previous experiments indicated that the yield increases with the amount of seed, but that when large whole potatoes are used for seed there are very many small potatoes in the crop. The most profitable results were obtained when small whole potatoes were planted.

Maryland vs. Vermont potatoes for seed (pp. 374–376).—This is a continuation of an experiment made in 1889 and 1890, as recorded in the Annual Reports of the station for those years (E. S. R., vol. II, p. 349, and III, p. 515). The results for 7 varieties grown in 1891 show an average yield of 88 bushels per acre for the Maryland seed and 152 bushels for the Vermont seed.

Miscellaneous (pp. 376–378).—Brief notes on experiments with beets and flaxseed and in feeding animals.

Field experiments, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1891, pp. 180–217*).

Synopsis.—Notes are given on experiments with a number of different species and varieties of grasses, forage plants, cereals, root crops, and vegetables; with Stowell Evergreen and Pride of the North corn for silage; and in the improvement of grass land. There are also general statements regarding the farm work of the station.

Grass experiments (pp. 180–186).—Notes are given on the growth at the station of Kentucky blue grass, English rye grass, Italian rye grass, meadow fescue, herd's grass, and mixtures of redtop with English rye grass, Italian rye grass, herd's grass, and meadow fescue. These were each grown on plats 175 by 33 feet (two fifteenths of an acre).

Experiments with field and garden crops (pp. 187–197).—Notes are given on white soja beans, black soja beans, serradella, Bokhara clover, spring vetch, white vetch, kidney vetch, sainfoin, yellow trefoil, yellow lupine, white lupine, forest pea (*Lathyrus sylvestris*), common buckwheat, Japanese buckwheat, silver hull buckwheat, stachys tubers, Chinese potato bulblets, prickly comfrey, English rye grass, 15 varieties of wheat, Kansas King corn. Jerusalem corn, and 5 varieties of sugar beets, the seed for some of which were sent by the U. S. Department of Agriculture. The yields are given of spinach, beets, potatoes, lettuce, celery, kohlrabi, cabbages, and tomatoes raised on plats manured with mixtures of 30 pounds muriate of potash, 40 pounds dissolved boneblack, and either 75 pounds dried blood, 47 pounds nitrate of soda, or 38 pounds ammonium sulphate.

"A critical discussion of the results is deferred to a later period in our investigation, when the experience of several years will furnish a safer basis for deduction."

Experiments with Stowell Evergreen sweet corn for silage (pp. 198, 199).—Stowell Evergreen corn was grown on 2 fertilized plats, the seed for 1 plat being received from the U. S. Department of Agriculture. The yields and analyses are given.

Pride of the North corn for silage (pp. 207, 208).—The yield and composition of Pride of the North corn grown for silage.

Experiments with grass land (pp. 209–215).—An account is reprinted from the previous report on the improvement of a meadow consisting of 16 to 17 acres and its treatment since 1886, together with the yields of hay in 1891 from plats receiving different kinds of fertilizers.

Report on general farm work (pp. 216, 217).—Brief remarks on the current farm work and a statement of the amounts of hay and other feeding stuffs raised during the year.

HORTICULTURE.

A. C. TRUE, *Editor*.

Experiments with fertilizers on tomatoes, E. B. VOORHEES (*New Jersey Stas., Report for 1891, pp. 85–108*).—A reprint of Special Bulletin O of the station (E. S. R., vol. III, p. 879).

Experiments with fertilizers on sweet potatoes, E. B. VOORHEES (*New Jersey Stas. Report for 1891, pp. 124–132*).—A reprint from Special Bulletin P of the station (E. S. R., vol. III, p. 883), together with analyses of the potatoes grown with different fertilizers.

Experiments with fertilizers on peach trees, E. B. VOORHEES (*New Jersey Stas. Report for 1891, pp. 133–138*).

Synopsis.—Nitrate of soda, superphosphate, and muriate of potash, singly or in combination, plaster, manure, and manure and lime were compared with no manure

on Crawford Malacatoon peaches. Nitrate of soda alone did not increase the yield. The other two fertilizers alone or combined, and especially complete fertilizers, were effective. The largest yields were from barnyard manure. On the basis of cost of fertilizer per basket of peaches, the best return was from muriate of potash alone, followed by the complete fertilizer. On the basis of the selling price, the largest net profit was from the complete fertilizer.

This is a continuation of an experiment on the farm of S. C. Dayton, commenced in 1884. Nitrate of soda 150 pounds, superphosphate 350 pounds, and muriate of potash 150 pounds were used singly, two by two, and all three together; plaster 400 pounds, barnyard manure 20 two-horse loads, and a mixture of 10 loads of barnyard manure and 50 bushels of lime per acre, were each used on one plat; and two plats remained unmanured.

The variety of fruit is Crawford late Malacatoons. The first crop was picked in 1887. This was a small crop. In 1888 a good crop was secured. In 1889 the crop was again small, and in 1890 it was an entire failure, as elsewhere in the State. This year a very large crop was picked, though poor in quality, as stated by Mr. Dayton. The orchard was visited by the chemist of the station on September 10, at which time many trees were still overloaded with fruit, but little of which could be considered as first class. * * *

[The yields and financial results in 1891 are fully tabulated.] Of the single elements, nitrate of soda has not increased the yield, plat 2 barely holding its own with plat 1 (unfertilized). Both superphosphate and muriate of potash have been effective, though decidedly in favor of the potash. The increased yields from combinations of two elements are large and practically uniform. The best yield from chemical manures is from the complete fertilizer, but this is forty baskets lower than that from the barnyard manure. * * *

[Concerning the pecuniary results,] muriate of potash was the most valuable of the single elements, giving a greater net gain than barnyard manure, while nitrate of soda was of no value. The most profitable combination of two elements was on plat 8, with muriate of potash and superphosphate, though nitrate of soda was decidedly beneficial when used in connection with either and in all cases more profitable than large dressings of barnyard manure. The largest net gain ($308.79), was on plat 9, from complete chemical manure.

In view of the variable factor of selling price, the cost of fertilizer per basket would perhaps better express the relative effect of the different materials used.

On this basis it appears that up to the present time the single fertilizing elements have produced peaches at a less cost per basket than either combinations of two elements or of all three in the form of a complete fertilizer. The best return for money expended was secured from the muriate of potash. The complete manure on plat 9 was superior to combinations of two elements, except on plat 8 [superphosphate and muriate of potash], and also to barnyard manure. It must be remembered, however, that the larger yields at a higher cost per basket may be the most satisfactory. For instance, if the average selling price were but 25 cents, 400 baskets at 20 cents profit would be less satisfactory than 800 at a profit of 15 cents.

The yields are given of corn grown with different fertilizers in a peach orchard on the farm of S. S. Voorhees.

Experiments with fertilizers on turnips, E. B. VOORHEES (*New Jersey Stas. Report for 1891, pp. 139–141*).

Synopsis.—Mixed minerals and a complete fertilizer were compared with farm manure, alone and with chemical fertilizers, and with no manure on turnips. Drouth

reduced the crop. All the fertilizers used increased the yield, but the complete fertilizer was somewhat more effective than barnyard manure. Kainit was the most effective form of potash. Financially the mixed minerals and the complete fertilizer were decidedly and almost equally profitable. There was no profit from barnyard manure.

This experiment was planned for potatoes, and the land was prepared and manured as described in the potato experiments mentioned above (p. 30). The potatoes failed to germinate and turnip seed were sown in drills on all the plats. The early season was favorable but the crop suffered severely from the drouth in September. The yields of roots and tops are tabulated.

"The comparative effect of the different methods of manuring is shown in the following table, where the plats are grouped:"

	Turnips per acre.	Tops per acre.	Gain.	
			Turnips.	Tops.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Unfertilized	6.1	2.7	....	......
Minerals alone	9.5	3.3	3.4	0.6
Minerals and nitrogen	10.2	2.8	4.1	0.1
Barnyard manure	9.9	2.1	3.8	—0.6
Barnyard and mixed chemical manures	9.9	2.3	3.8	—0.4

A very decided gain is secured from minerals alone—an average of 3.4 tons or over 55 per cent. The addition of nitrogen to the minerals increased the yield to 4.1 tons—a gain for the nitrogen of 0.7 tons. The gains from 20 tons of barnyard manure and from 10 tons of barnyard manure with half quantity of chemical manure were identical, viz, 3.8 tons; on this basis of yield, therefore, the chemical manures were on the average superior to the barnyard manure and the barnyard manure was superior to the chemicals without nitrogen. * * * The average yields for the different forms of potash are as follows, calculated on the basis of an acre:

	Tons.
Yield from muriate	8.7
Yield from sulphate	10.2
Yield from kainit	11.0

The sulphate gave a yield of 1.5 tons, or 17 per cent greater than the muriate, while from kainit the yield was 2.3 tons, or 26 per cent greater than from muriate. * * *

In this section, where turnips are used in the dairy, they are regarded as worth $8 per ton. Assuming that the yield on the unfertilized plats paid expenses, the profits from the different methods of manuring are:

	Value of the increased crop.	Cost of fertilizer.	Net profit.
Minerals alone	$27.20	$8.10	$19.10
Complete manure	32.80	12.74	20.06
Barnyard manure	30.40	30.00	0.40
Barnyard manure and chemical manure	30.40	21.77	8.63

A very decided gain was secured in all cases except from barnyard manure, which simply paid expenses when not including the extra cost of handling. The complete fertilizer though the most profitable was but little ahead of the minerals alone.

Experiments with nitrate of soda on strawberries, E. B. VOORHEES (*New Jersey Stas. Report for 1891, pp. 141, 142*).

Synopsis.—Nitrate of soda was compared with manure on Sharpless strawberries on 2 eighth-acre plats of sandy loam liberally manured two years before with kainit and phosphate. Nitrate of soda increased the vigor of the plants and the yield of fruit mainly by enlarging the individual berries. The net increase in profit was at the rate of about $40 per acre.

Sharpless strawberries were set in 1889 on 2 eighth-acre plats of sandy loam land, both plats being manured at that time with 1,500 pounds per acre of a mixture of kainit and precipitated phosphate. In the spring of 1891 nitrate of soda, 200 pounds per acre, was broadcasted on 1 plat, the other remaining untreated. "A very decided difference was noticed in the appearance of the plants on the 2 plats, those on the untreated plat showing a deeper color, larger leaves, and a much stronger bloom." The yields of berries were, without nitrate 162 quarts per plat, with nitrate 213 quarts per plat.

The gain in yield from the use of nitrate was 51 quarts or 31 per cent, and was due mainly to the increased size of the fruit; the number of berries was apparently little increased.

The berries were sold in the New Brunswick markets; the selling price averaged 10⅞ cents per quart. There was therefore a gain of $5.54 per plat or $44.32 per acre. The nitrate cost $45 per ton, which made the cost of the amount used $4.50 per acre, in reality a return of 10 cents for every cent invested in the nitrate. There is no doubt but that this large increase in yield from nitrate of soda alone this year was made possible by the presence in the soil of considerable amounts of mineral elements supplied by the dressing of phosphate and potash in 1889, though it forcibly illustrates the profits that may be derived from special manuring.

Report of horticulturist of Maryland Station, T. L. BRUNK (*Maryland Sta. Report for 1891, pp. 379–421, figs. 8*).

Synopsis.—The subjects treated are (1) the station orchards; (2) spraying experiments; (3) spraying apparatus; (4) test of varieties of tomatoes; (5) potted *vs.* transplanted tomato plants; (6) fertilizer test with tomatoes; (7) test of varieties of strawberries, blackberries, and lettuce; (8) root rot of peas; and (9) winter budding.

The station orchards (pp. 379–391).—Notes and tabulated data on experiments with Paris green combined with ammoniacal copper carbonate, copper carbonate and carbonate of ammonia, or kerosene emulsion and copper carbonate, on apple trees of the Winesap and Limbertwig varieties. Ravages by insect pests were diminished by the treatment, but as regards fungous diseases the results were inconclusive. Paris green in combination with the copper compounds was quite injurious to the foliage. The mixture containing kerosene emulsion was prepared as follows:

Three bars (about 27 ounces) of Lenox soap [were first dissolved] in 3 gallons of hot water. This was poured into a barrel or half barrel, and to it was first added 1 pound of carbonate of copper and 2¼ ounces of Paris green. The whole was then thoroughly mixed with a large Lewis combination syringe by repeatedly spraying it back into the barrel. The soap is a good suspender of both the carbonate of copper and Paris green. Six quarts of kerosene oil were finally added and thoroughly churned

with the syringe till well emulsified into a green, milky mixture. This was then diluted to 28 gallons and sprayed upon the trees. The Paris green remained suspended very well and did not need as much agitation as when sprayed with water alone. The cost was about 51 cents for 28 gallons.

An improved ammoniacal copper carbonate was prepared by the station chemist by dissolving 3 ounces of copper carbonate and 1 pint of ammonia in 4 gallons of water containing about 5 pounds of carbonate of soda. This mixture was diluted with 50 gallons of water. It was found that pyrethrum could be used with this mixture.

Bordeaux mixture was successfully used on watermelons, cucumbers, muskmelons, pumpkins, squashes, tomatoes, strawberries, and quinces. Spraying with copper compounds did not prevent injuries to blackberries by red rust (*Cæoma nitens*).

Spraying apparatus (pp. 391–399).—Illustrated descriptions of various forms of spraying apparatus.

Test of varieties of tomatoes (pp. 400–407).—Notes and tabulated data on a test of 84 varieties, in continuation of that recorded in Bulletin No. 11 of the station (E. S. R., vol. II, p. 728). The varieties producing fruit at the rate of 15 or more tons per acre were Brandywine, Mayflower, Long Keeper, Fulton Market, Golden Sunrise, Table Queen, Annie Dine, Livingston Stone, Puritan, Hundred Days, Bronze Leaf, Burpee Climax, Extra Early Advance, Favorite, Paragon, Extra Early Jersey, McCullom Hybrid, Horsford Prelude, Buist Beauty, Ignotum, Matchless, Beauty, Peach, Volunteer, Morning Star, Golden Trophy, Little Gem, and Large Yellow. Of these, Long Keeper, Hundred Days, Extra Early Advance, and Horsford Prelude were among the earliest varieties.

Potted vs. transplanted tomato plants (pp. 407–410).—A repetition of the test recorded in the bulletin cited above. The results in 1891, as tabulated, confirm those of the previous year in showing that the potted plants matured more fruit than the transplanted plants, and that a large portion of it was produced earlier in the season.

Fertilizer test with tomatoes (pp. 410–412).—Notes and tabulated data on an experiment in continuation of that recorded in the bulletin cited above. The varieties planted were Acme, Favorite, Atlantic Prize, Beauty, Dwarf Champion, Ignotum, and Horsford Prelude. The fertilizers were nitrate of soda, dried blood, dissolved boneblack, and muriate of potash, used singly, two by two, and all three together, on 10 plats, 2 plats receiving no manure. The yields on all the plats were very small, but in a general way confirmed those of previous years in indicating that nitrate of soda is the best single fertilizer for tomatoes and that good results are obtained from the use of a complete fertilizer.

Tests of varieties of strawberries, blackberries, and lettuce (pp. 412–420).—A summary is given of a test of 118 varieties of strawberries. The most productive varieties were Staymen No. 1, Sadie, Warfield, Mrs. Cleveland, Clingto, and Staymen No. 2. The earliest varieties

were Michel Early, Hoffman, and Van Deman. The best varieties were more productive when cultivated in hills than in matted rows.

Tabulated data and descriptive notes are given for 19 varieties of blackberries. Early Harvest, Minnewaski, and Thompson Early Mammoth were the most productive.

Brief statements are made regarding a test of 77 varieties of lettuce. The best varieties grown for outdoor culture were Hanson, Grand Rapids, Denver Market, Sunset, Early Curled Simpson, Cal. All Heart, Paragon, and Early Curled Silesia.

Root rot of peas (pp. 420, 421).—A brief account of observations on a root disease of peas at Harmans, Anne Arundel County, Maryland.

Winter budding (p. 422).

[Japan seedling pear stocks] were placed on the eighth of April in a hotbed having 6 inches of sand over the heating material. Both the heat of the sun and the manure beneath caused the sap to start in the stocks, and in eight days they were ready to bud by the ordinary method. They were taken to a warm room, budded with Mikado pear buds, and then placed back in the sand to take. In about eight days more they had all taken nicely and were transferred to damp sawdust to await planting in the nursery and to prevent them from growing. A few days later they were set in the nursery. During the summer they had good culture and made an average growth of 2 feet. They were all vigorous and large enough to be transplanted to the orchard by fall. This method is practicable on a large scale, and it may be that a large and more convenient incubator can be devised to start the sap enough so the bark will run and in which to place stocks when budded to make them take.

The station vineyard (*Maryland Sta. Bul. No. 15, Dec., 1891, pp. 225–230*).—A classified list of the varieties of grapes planted and general statements regarding the arrangement and culture of the vineyard.

Analyses of plants, fruit, etc. (*Massachusetts State Sta. Report for 1891, pp. 296, 297, 327–336*).—Tabulated analyses of carnation pinks (whole plant), grapes, sound wood of plums, black knot of the plum, banana skins, and miscellaneous fruits.

Plowing to different depths, E. S. RICHMAN (*Utah Sta. Bul. No. 14, June 1, 1892, pp. 1, 2*).—An account of an experiment in which plats used for cabbages, peas, carrots, sweet corn, and potatoes were plowed to a depth of 3, 6, or 9 inches. In the case of peas the shallowest plowing gave the best results, in the other cases the deepest plowing.

FORESTRY.

Report on forestry, C. A. KEFFER (*South Dakota Sta. Bul. No. 29, Dec., 1891, pp. 3–28*).

Synopsis.—Notes on the growth of a number of species of trees planted on experimental plats at the station.

The following table gives the average growth of different species during three years (1889–'91). "All the figures are averages obtained by measuring a number of leading branches on the trees showing the greatest, least, and average growth."

Variety.	Total growth in inches.								
	1889.			1890.			1891.		
	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
Populus pyramidalis	23	10	16	40	18	36	43	16	35
Populus nolester	80	5	18⅛	38	18	35	46	20	37½
Black walnut	7½	1½	4¼	9	3	6	20	6	18
White walnut	9¼	1¼	6¼	......	......	......	......	......	......
Yellow birch	10	3	6	30	7	20¼	36	9	21
White oak	5	1	1⅜	9	2	5⅓	13	7	10
White birch	7¾	2½	5¼	29	12	16	40	10	23
White elm	24	3	9½	42	10	22¾	46	15	32
Black wild cherry	12	4	8	26	6	16	32	20	28¾
Soft maple	12¼	4	8⅝	35	16	22½	45	26	34⅓
Salix fragilis	8½	8	15¼	30	18	24	40	22	29¾
Scotch pine	7¾	2¼	4¾	9	2	5	16	2	4
Larch	7½	2⅜	5	14	8	11⅛	16	5	11½
Black Hills spruce	5½	1	2¾	4	1	2½	2½	2	2¼
White pine	7½	0½	4⅓	8	1	4⅓	......	......	......
Populus certinensis	39	9	25⅛	40	14	37	34	10	24¼
Box elder, 1 year old *	32	3¼	10¾	38	10	28¾	39	22	32
Box elder, 2 years old *	34	5½	18	45	20	37½	54	24	38⅓
Cottonwood, 1 year old *	25	4½	15½	66	16	40¼	40	19	29¼
White ash	14	3	9½	34	8	22¼	31	6	19

* When transplanted.

WEEDS.

Notes on weeds, B. D. HALSTED (*New Jersey Stas. Report for 1891, pp. 313–340*).

Synopsis.—This includes a report on the study of weed roots, statements regarding the migration of weeds, a comparison of the species of weeds found in Eastern and Western States, general statements showing why foreign weeds become so troublesome in this country, and the importance of taking measures for the extermination of weeds.

In connection with the making of a collection of 100 of the worst weeds, to be distributed to agricultural colleges, experiment stations, and other institutions, the roots of these species were carefully studied. The root systems were classified into taproots, fascicled roots, and root systems with tap and fascicled roots combined. Under each of these heads the roots were divided into five classes according to size. The results of this classification for the 100 species in the collection were as follows:

Perennial weeds with taproots.—(1) *Very large*—Bouncing Bet (*Saponaria officinalis*), St. John's wort (*Hypericum perforatum*), burdock (*Arctium lappa*), Canada thistle (*Cnicus arvensis*), dandelion (*Taraxacum officinale*), dogbane (*Apocynum cannabinum*), bindweed (*Convolvulus arvense*), bracted bindweed (*C. sepium*), man-of-the-earth (*Ipomœa pandurata*), and curled dock (*Rumex crispus*); (2) *large*—mallow (*Malva*

rotundifolia), passion vine (*Passiflora incarnata*), chicory (*Cichorium intybus*), heal-all (*Brunella vulgaris*), and catnip (*Nepeta cataria*); (3) *medium*—sneezeweed (*Helenium tenuifolium*), ground ivy (*Nepeta hederacea*), and three-seeded mercury (*Acalypha virginica*); (4) *small*—none; (5) *very small*—none.

Biennial weeds with taproots.—(1) *Very large*—nonesuch (*Medicago lupulina*), evening primrose (*Œnothera biennis*), wild carrot (*Daucus carrota*), parsnip (*Pastinaca sativa*), teasel (*Dipsacus sylvestris*), hound's tongue (*Cynoglossum officinale*), blue weed (*Echium vulgare*), moth mullein (*Verbascum blattaria*), and mullein (*Verbascum thapsus*); (2) *large*—yellow rocket (*Barbarea vulgaris*); (3) *medium*—stick-seed (*Echinospernum lappula*); (4) *small*—dead nettle (*Laminum amplexicaule*); (5) *very small*—none.

Annual weeds with taproots.—(2) *Large*—black mustard (*Brassica nigra*), shepherd's purse (*Capsella bursa-pastoris*), field pepper grass (*Lepidium campestre*), pepper grass (*L. virginicum*), hedge mustard (*Sisymbrium officinale*), corn cockle (*Lychnis githago*), velvet leaf (*Abutilon avicennæ*), mayweed (*Anthemis cotula*), cocklebur (*Xanthium canadense*), purple thorn apple (*Datura tatula*), horse nettle (*Solanum carolinense*), tumbleweed (*Amarantus albus*), pigweed (*A. chlorostachys*), pigweed (*A. retroflexus*), goosefoot (*Chenopodium album*), black bindweed (*Polygonum convolvulus*); (3) *medium*—charlock (*Brassica sinapistrum*, *B. arvensis*), wild radish (*Raphanus raphanistrum*), bladder ketmia (*Hibiscus trionum*), carpet weed (*Mollugo verticillata*), button weed (*Diodia teres*), sow thistle (*Sonchus oleraceus*), knot grass (*Polygonum aviculare*), spurge (*Euphorbia preslii*), and spotted spurge (*Euphorbia maculatæ*); (4) *small*—chickweed (*Stellaria media*), and purslane (*Portulaca oleracea*); (5) *very small*—none.

Perennial weeds with fascicled roots.—(1) *Very large*—*Sedum telephium*; (2) *large*—milkweed (*Asclepias syriaca*), toadflax (*Linaria vulgaris*), climbing buckwheat (*Polygonum dumetorium*), and quack grass (*Agropyrum repens*); (3) *medium*—tall buttercup (*Ranunculus acris*), orange hawkweed (*Hieracium aurantiacum*), cone flower (*Rudbeckia hirta*), and coco grass (*Cyperus rotundus*); (4) *small*—bulbous buttercup (*Ranunculus bulbosus*), and oxeye daisy (*Chrysanthemum Leucanthemum*); (5) *very small*—none.

Biennial weeds with fascicled roots.—(1) *Very large*—none; (2) *large*—white melilot (*Melilotus alba*) and fleabane (*Erigeron strigosus*); (3) *medium*—fleabane (*Erigeron canadensis*); (4) *small*—none; *very small*—wild onion (*Allium vineale*).

Annual weeds with fascicled roots.—(1) *Very large*—none; (2) *large*—none; (3) *medium*—chamomile (*Anthemis arvensis*), fireweed (*Erechlitis hieracifolia*), smartweed (*Polygonum pennsylvanicum*), chess (*Bromus secalinus*), barnyard grass (*Panicum crus-galli*), crab grass (*P. sanguinale*); (4) *small*—chess (*Bromus tectorum*), witch grass (*Panicum capillare*), and the two foxtails (*Setaria glauca* and *S. viridis*); (5) *very*

small—speedwell (*Veronica peregrina*), broom rape (*Orobanche ramosa*), sandbur (*Cenchrus tribuloides*), and wire grass (*Eleusine indica*).

Perennial weeds with mixed roots.—(2) *Large*—motherwort (*Leonurus cardiaca*), the two plantains (*Plantago lanceolata* and *P. major*), and sorrel (*Rumex acetosella*).

Annual weeds with mixed roots.—(2) *Large*—Texas horse nettle (*Solanum rostratum*), spreading pigweed (*Amarantus blitoides*), and goosefoot (*Chenopodium ambrosioides*); (3) *small*—horseweed (*Ambrosia trifida*) and ragweed (*A. artemisiæfolia*).

Oregon weeds, M. CRAIG (*Oregon Sta. Bul. No. 19, May, 1892, pp. 21, plates 19*).

Synopsis.—General statements regarding the growth and extermination of weeds, the text of State laws for the extirpation of the Canada thistle and dagger cocklebur, and popular descriptions of a number of species which are among the worst weeds of Oregon.

The worst weeds in Oregon include the following species: Larkspur (*Delphinium* sp.), aconite (*Aconitum fischeri*), wild mustard (*Brassica campestris*), winter cress (*Barbarea vulgaris*), shepherd's purse (*Capsella bursa-pastoris*), alfilaria (*Erodium cicutarium*), poison oak (*Rhus diversiloba*), poison ivy (*R. toxicodendron*), sweet clover (*Melilotus alba*), bur clover (*Medicago denticulata*), wild gourd (*Megarrhiza oregona*), dagger cocklebur (*Xanthium spinosum*), tarweed (*Madia sativa*), mayweed (*Anthemis cotula*), oxeye daisy (*Chrysanthemum Leucanthemum*), Canada thistle (*Cnicus arvensis*), common thistle (*C. lanceolatus*), burdock (*Arctium lappa*), French pink (*Centaurea cyanus*), sow thistle (*Sonchus oleracea*), pepper weed (*Gilia squarrosa*), dodder (*Cuscuta racemosa*), mullein (*Verbascum thapsus*), moth mullein (*V. blattaria*), narrow-leaved plantain (*Plantago lanceolata*), yellow dock (*Rumex crispus*), sheep sorrel (*R. acetosella*), pigweed (*Amarantus retroflexus*), lamb's quarters (*Chenopodium album*), wild oats, (*Avena fatua*), chess (*Bromus secalinus*), couch grass (*Agropyrum repens*), and common brake (*Pteris aquilina*).

DISEASES OF PLANTS.

Report of vegetable pathologist of Massachusetts State Station, J. E. HUMPHREY (*Massachusetts State Sta. Report for 1891, pp. 218–248, plate 1*).

Synopsis.—This includes notes on the rotting of lettuce, powdery mildew of the cucumber, and various other plant diseases, with suggestions for the preventive treatment of fungous diseases and especially of smuts.

Rotting of lettuce (pp. 219–222).—An account of observations by the author on a fungus which causes the rotting of lettuce grown under glass.

The structure of the fungus is very simple. From the creeping vegetative threads arises the erect spore-bearing ones which branch sparingly toward their tips. The

ends of the branches become slightly swollen, and from each is developed a number of short, peglike projections. Each of these now begins to swell at its tip into a globular body, which increases in size and finally becomes elliptical in form. This is the spore, which when ripe falls from its attachment. The spores germinate promptly in water or a nutrient solution by pushing out one or more threads each. These threads when supplied with nourishment grow rapidly into a much-branched mycelium. In a few days the erect spore-bearing threads begin again to be formed, as above described. Well-nourished specimens growing in a moist atmosphere may, after the first spore cluster has been formed, put out a new branch from the fertile thread just below the cluster of spores. This thread then grows to a considerable length and then develops at its tip a new spore cluster, and this process may be several times repeated. The result of such a course of development is to produce what appear to be very long, fertile threads, with spore clusters scattered at intervals along them.

Instead of a spore cluster a thread may produce, apparently only when it comes in contact with some solid substance, a compact cellular mass, which clings closely to the surface with which it is in contact. * * *

Careful examination of a quantity of material has failed to show any sclerotia, but it is by no means certain that they may not be formed at least in some cases.

In its development, so far as observed, and in the details of its structure, this fungus appears to agree with the form known as *Botrytis* (*Polyactis*) *vulgaris*, Fr., and is with little doubt the conidial stage of some sclerotium-producing *Peziza* (*Sclerotinia*).

Thorough disinfection of the greenhouse and careful culture of the plants will very largely prevent loss from rotting.

Powdery mildew of the cucumber (pp. 222–226).—So far as known to the author the first announcement of this disease in this country was made in Bulletin No. 40 of the station (E. S. R., vol. III, p. 162). Plants affected with the disease were sent to the station by J. Fisher of Fitchburg, Massachusetts, and L. H. Bailey of the New York Cornell Station.

The disease ordinarily appears first on the upper surfaces of the leaves and sometimes on the stems of the host plants in the form of small, roundish white spots, which have the peculiarly powdery appearance which has given to this group of fungi their name. These young spots suggest the effect of scattered splashes of flour upon the plant. Microscopic study shows that the white substance consists of the threads and spores of the parasite. The surface of the host plant is covered by a close layer of flattened cells, the epidermis, and the vegetative threads of the parasite develop close to this outer surface. * * *

The superficial threads grow and branch freely and soon begin to send up erect, vertical threads, from which, after they have reached a certain length, spores are formed by the cutting off of the tip and of successively lower portions by consecutively formed cell walls. Each oblong segment becomes in its turn rounded off at the angles and somewhat enlarged at the middle and then falls from its support ready for germination. On a well-developed thread one may thus see a chain of spores in all stages of development. These spores may vary considerably in size in specimens from the same source; but they do not usually, if ever, differ so widely as do those from Dr. Fisher's and Prof. Bailey's specimens. Between the two there is a considerable difference in form as well as in size, which may point to a specific difference in the parasites from the two sources. * * *

These spores when fully ripe germinate readily in water, but do not develop far. Each gives rise to a germ tube, usually near one of the original corners of the spore; but this tube rarely reaches a length greater than twice the short diameter of the spore. On nutrient gelatin prepared with an infusion either of prunes or cucumber leaves, the spores will develop no farther than in water; but in a drop of water

on the surface of a living cucumber leaf they send a branch of the germ tube downward, as a haustorium, into the underlying epidermal cell, and then grow and branch freely, until a considerable mycelium, forming a spot upon the leaf, is developed. From the readiness with which the leaf and stem and all succulent parts of the plant are attacked in this way, the disease spreads rapidly or may be artificially communicated to healthy plants. * * * It has been known as the variety *Cucurbitarum* of *Oidium erysiphoides*, Fries, which embraces various undetermined summer-spore stages of this group. But during last December on several of the leaves of cucumber plants on which the disease had been allowed for six weeks to run its course and which were covered by the summer spores of the fungus, there appeared smoky spots perhaps half an inch in diameter. On these spots were seen the young yellow and brown spore fruits or perithecia of the winter stage. These soon reached maturity and furnished the means for specific identification of the parasite. The dark-brown ripe perithecia are provided with irregular brownish appendages around their bases, and contain several spore sacs each. Each spore sac contains typically and most commonly two spores, but this number is often reduced to one and less often rises to three or even four. A careful comparison of this fungus with the described species of the genus *Erysiphe*, to which it plainly belongs, shows it to agree in all essential details of structure, perithecia, haustoria, etc., with *E. cichoracearum* DC. * * *

Prof. Bailey and Dr. Fisher, as well as the writer, have found that this disease may be kept in check in the greenhouse by spraying the plants as often as is necessary with a solution of sulphide of potassium (liver of sulphur) in water, an ounce of the sulphide to 4 gallons of water. A stronger solution injures the plants and fruits. Spraying with the ammoniacal carbonate of copper has been found even more effective. But Prof. Bailey finds more effective than either exposure to sulphur vapor. This is accomplished by closing the house as tight as possible for half an hour or an hour at a time, while it is filled by the vapor arising from a vessel of sulphur kept a little above the melting point on a small oil stove. The vessel should be porcelain-lined to protect the iron from the action of the sulphur. This vapor appears to be harmless to the host plants, while fatal to surface parasites like the powdery mildews.

Miscellaneous notes (pp. 226–235).—A brief account is given of observations on a disease of the potato plants, caused by a fungus apparently belonging to the genus *Macrosporium*.

An undetermined disease of cucumbers was also studied by the author from specimens sent from Fitchburg, Massachusetts.

This disease is characterized by a dwarfed and stunted appearance of the shoots attacked. The young fruits become deformed and distorted, and some of the leaves which reach a considerable size, perhaps because they are attacked late, turn yellow and die. Sometimes a plant will push out a new and vigorous shoot which may grow for a time, but sooner or later is pretty sure to succumb. Over the lower surface of these yellow leaves may be seen on close examination, a delicate, white, glairy film, which recalls by its appearance a very thin, dried streak of some albuminous substance. Microscopic study of this film shows it to be a web of very fine interlacing fungus threads, closely adherent to the surface of the leaf. No spore formation was ever observed on the leaves as they come from the forcing house; but when a fresh leaf, covered with a well-developed film, was placed in a moist chamber the threads gave rise in two or three days to numerous short, erect stalks, irregularly scattered along their sides. These stalks taper somewhat toward their tips, which are rounded or slightly knobbed, and bear the elliptical or rather kidney-shaped spores of the fungus. These spores when placed in water swell up by absorption of water until they become nearly or quite spherical in form, and then germinate by extending a germ tube nearly as large as the average of the vegetative filaments of the fungus.

Brief notes are also given on three kinds of fungi attacking winter rye (*Urocystis occulta*, *Puccinia rubigo-vera*, and *Cladosporium herbarum*), club root of cabbages (*Plasmodiophora brassicæ*), blights of celery (*Cercospora apii* and a form of *Septoria*), two clover fungi, (*Uromyces trifolii* and *Polythrincium trifolii*), a fish hatchery fungus (*Achlya racemosa*), rust of poplars (*Melampsora populina*), and anthracnose of chestnuts (*Marsonia ochroleuca*). Studies on black knot of the plum are in progress.

Preventive treatment of fungous diseases (pp. 235–248).—General directions are given for the prevention of diseases of plants by hygienic treatment and by the use of fungicides. The methods of preparation and use of various fungicides are described. Smuts of oats, barley, wheat, rye, and corn are briefly described, with illustrations, and directions for their treatment are given.

Notes on fungi, T. A. WILLIAMS (*South Dakota Sta. Bul. No. 29, Dec., 1891, pp. 29–52*).

Synopsis.—General statements are made regarding the nature and treatment of fungous diseases of plants, and directions are given for treating the seed of grain with hot water and with potassium sulphide. There are also brief notes on species of fungi more or less prevalent at the station.

The fungi more or less prevalent at the station include the following species: (1) Fungi injurious to useful plants—*Peronospora arthuri*, *P. violæ*, *Podosphæra tridactyla*, *Sphærotheca pannosa*, *S. mors-uvæ*, *Microsphæra alni*, *Erysiphe communis*, *Sphæria ulmæ*, *Phyllachora graminis*, *Plowrightia morbosa*, *Rhytisma acerinum*, *Uromyces trifolii*, *Melampsora farinosa*, *M. populina*, *Puccinia coronata*, *P. graminis*, *P. pruni*, *P. stipæ*, *P. violæ*, *Æcidium fraxini*, *Æ. grossulariæ*, *Uredo cæoma-nitens*, *Ustilago avenæ*, *U. hyphodytes*, *U. maydis*, *U. nuda*, *U. tritici*, *Vermicularia denudata*, *Stegonospora spinaceæ*, *Septoria pruni*, *S. ribes*, *S. rubi*, *Piggotia fraxini*, *Oidium erysiphoides*, *Ramularia armoraciæ*, *R. tulasnei*, *Scoletotrichum maculicola*, *Cercospora beticola*, *C. circumscissa*, *Ceratophorum ulmicolum*; (2) fungi injurious to weeds—*Empusa muscæ*, *Peronospora cyparissiæ*, *P. leptosperma*, *Sclerospora graminicola*, *Plasmopara halstedii*, *Cystopus bliti*, *C. candidus*, *C. portulacæ*, *C. tragopogonis*, *Erysiphe euphorbiæ*, *Uromyces polygoni*, *U. rudbeckiæ*, *Puccinia convolvuli*, *P. emaculata*, *P. helianthi*, *P. polygoni*, *P. prenanthis*, *P. taraxaci* *P. xanthii*, *Phragmidium speciosum*, *P. subcorticum*, *Æcidium apocyni*, *Æ. compositarum*, *Æ. euphorbiæ*, *Æ. jamesianum*, *Æ. urticæ*, *Æ. verbenæ*, *Ustilago panici-miliacei*, *Entyloma physalidis*, *Septoria asclepiadicola*, *S. atriplices*, *S. erigerontis*, *S. lactucicola*, *S. polygonorum*, *S. rudbeckiæ*, *Ovularia obliqua*, *Ramularia arvensis*, *Cercospora avicularis*, *C. clavata*, *C. ziziæ*; (3) fungi injurious both to useful plants and weeds—*Peronospora effusa*, *P. parasitica*, *Claviceps purpurea*, *Puccinia menthæ*, *Coleosporium solidaginis*, *C. sonchi*, *Septoria œnotheræ*, *Periculario grisea*, *Cercospora rosicola*.

Report on fungous diseases of plants, B. D. HALSTED (*New Jersey Stas. Report for 1891, pp. 233–340, figs. 21*).

Synopsis.—General notes on fungous diseases of plants and their treatment, and notes on observations and experiments by the author on eleven species of *Peronosporæ*, diseases of celery, soil and black rots of sweet potatoes, raspberry anthracnose, tomato blight, diseases of the eggplant, anthracnose of the bean, a disease of Lima beans, germination tests of *Monilia fructigena*, causes of damping off, anthracnose of variegated plants, fungous diseases of various plants, and nematodes as enemies to plants.

General notes on fungi (pp. 235–246).—A brief historical statement regarding studies on fungi, and short notes on a number of species of fungi common on wild and cultivated plants.

Notes on Peronosporæ (pp. 247–249).—Brief notes on observations by the author on the following species: Potato rot (*Phytophthora infestans*), grape mildew (*Plasmopara viticola*), *P. pygmæa*, geranium mildew (*P. geranii*), lettuce mildew (*Bremia lactucæ*), crucifer mildew (*Peronospora parasitica*), cucumber mildew (*P. cubensis*), five-finger mildew (*P. potentillæ*), sweet potato mold (*Cystopus ipomææ-panduratæ*), white mold (*C. candidus*), and purslane mold (*C. portulacæ*).

Some fungous diseases of celery (pp. 250–259).—This article is reprinted from Special Bulletin Q of the station (E. S. R., vol. III, p. 884).

Field experiments with soil and black rots of sweet potatoes (pp. 260–266).—A condensed account of experiments reported in detail in Special Bulletin M of the station (E. S. R., vol. III, p. 703).

Field experiments with raspberry anthracnose (pp. 266, 267).—A brief account of experiments in which raspberries were sprayed with Bordeaux mixture, carbonate of copper and carbonate of ammonia, and carbonate of copper or sulphate of potassium. The results were negative.

An investigation of tomato blight (pp. 267–276).—A report of investigations by the author under direction of the Mississippi Station, which was also given in Bulletin No. 19 of the Mississippi Station (E. S. R., vol. III, p. 702).

Some fungous diseases of the eggplant (pp. 277–283).—Illustrated notes on observations by the author on seedling stem blight (*Phoma solani*), leaf spot (*Phyllosticta hortorum*), anthracnose (*Glœosporium melongenæ*), and stem rot (*Nectria ipomææ*).

Seedling stem blight is caused by a minute fungus which produces black specks embedded in the substance of the diseased portion of the plant.

Anthracnose "produces a shallow pit in the surface of the fruit upon which soon appear minute blotches tinged with pink." This disease has as yet been found only occasionally upon the eggplant.

Stem rot of the eggplant has been shown by the author to be due to a species of nectria which has also been found upon the sweet potato. "The nectria in question is closely related to Warlich's *Nectria vandæ*,

described in *Botanische Zeitung*, July 23, 1886, which is also a root disease, and quite destructive to an orchid (*Vanda suavis*)."

Anthracnose of the bean (pp. 284–287).—Observations are reported which showed that such beans as are commonly used for seed "may not only be infested with the anthracnose, but still more, are bearing spores upon the inner surface of the cotyledons, where by the natural shrinking of the seed a considerable cavity is often produced."

The fact that such seed produced diseased plants was determined by means of box experiments. Tests showed that the seeds could be freed from anthracnose by soaking "for one hour in a solution of 3 ounces of carbonate of copper and 1 quart of ammonia to 4.5 gallons of water."

A disease of Lima beans (p. 287).—A species of *Phyllosticta* was found not only to form spots on the leaves and pods of Lima beans, but also to cause the seeds to decay when planted.

Germination tests of Monilia fructigena (pp. 288–290).

During the middle of last May the writer brought a quantity of the cherry rot fungus (*Monilia fructigena*, Pers.) from Mississippi, where he gathered it upon the excrescences of a wild plum caused by *Taphrina pruni*, Tul. At that time the cultivated cherries in New Jersey were about the size of peas, and limbs bearing the fruit were placed in tall glass dishes containing water and covered with high bell jars. The fruit of one jar was inoculated with the Mississippi monilia, and after forty-eight hours there was a fine supply of the fungus covering the fruit, while the corresponding jar with fruit untreated in due time ripened the cherries free from the decay.

It is with this out-of-season laboratory supply of monilia that the following experiments were made. It was soon determined that the monilia spores were particularly well adapted for the study of germination. In distilled water at ordinary temperatures they quickly send out the single germ tube, and nearly always at one side of the oval hyaline spore. It requires from one to two hours for the production of a tube of a length exceeding that of the spore. In some cases after five hours the tube was five to ten times the diameter of the spore. Inoculations were easily made upon green and ripe tomatoes and various other vegetable substances, all demonstrating that this species of fungus is not confined to the stone fruits, where, however, it does its greatest damage, but will grow upon a wide range of organic compounds. Comparative tests were, however, made in pure cherry juice and that of tomato for example, and it was shown that the rate of development was about three times as fast upon cherry as upon tomato juice. Comparative tests were also made between spores in pure water and those in cherry juice. While they grew well in the distilled water the rate was greatly augmented by the cherry juice, and in forty hours there was a fine crop of spores, borne upon stalks, rising above the cherry juice, while no spores had been produced in the glass-slip well containing only the water.

Of more interest were the results obtained by testing the action of fungicides. The substance tested was the ammoniacal carbonate of copper compound, of various strengths, beginning with the strongest, that is, 3 ounces of the carbonate of copper to 1 quart of ammonia. By this the spores were killed, as also by the half, fifth, and twentieth strength. An extreme dilution was then substituted, namely, a 1 per cent strength of the fungicide as used for spraying grapes, etc., that is, one part of the ordinary vineyard strength was added to ninety-nine of pure water, which gave a liquid that contained so little of copper as to require a most delicate chemical test to detect its presence. In such a solution the spores would not germinate, but after several days, when the spores were washed five times and placed in pure

water, they grew slowly. In order to carry the tests a step farther, slides with pit cells were arranged with pure water in each, but into alternate ones a small bit of polished copper foil was dropped, the piece being in area equal to that of the lead at the end of a Faber pencil. That the presence of this minute amount of metallic copper should prevent the germination of the spores was surprising and only after many trials was the fact accepted. In only one case in a score or more was any spores with the copper found with tubes, and in this they had probably formed before the sowing was made. In no instance was there any failure of the spores to grow in the check cells with pure water only. That there might be no chance of any oxide of copper or other soluble compound being present, the foil was thoroughly scoured and rubbed to a bright polish. After the bit of copper was removed and the water changed the spores would sometimes germinate, the degree of activity depending somewhat upon the length of time they had been held in check. * * *

Since the above was written opportunity has offered to test the spores of a species of *Fusarium* and those of *Cercospora apii* (the celery blight) both of which germinate with remarkable rapidity in water. When surrounded with their congenial food, that is, an extract of the host plant, the rate over that of pure water is augmented many times. When copper is added to the water the spores fail to germinate, or in short the results are the same as those reported for monilia.

Similar experiments have been made with metallic zinc, but even when the spores were literally surrounded by the granulated metal they grew with vigor. A powdered form of metallic zinc was also used, and even in abundance had no retarding effect.

Damping off (pp. 290–293).—A brief discussion of the causes of what is called "damping off"—a term used to describe diseases of plants due to a number of different species of fungi.

Notes on anthracnose of variegated plants (pp. 293, 294).—An account of observations by the author on an anthracnose found on *Aspidistra lurida*, var. *variegata*, and on *Funkia undulata*, var. *variegata.*

The spores of this species were large, 20–28 by 3–5 μ, and crescent-shaped, while the setæ were few, almost black, long, and sharp-pointed. Sterilized petioles of the Aspidistra leaves in test tubes were sown with the spores and a fungus was readily produced in great abundance. In like manner the fungus developed with satisfactory rapidity upon slant agar-agar tubes, producing the spores in seeming clusters upon the tips of the threads, due to the fact that the spores were pushed to one side by those afterwards formed. In the germination of the spores there was usually formed first of all a dark body from which later a hyaline thread might or might not grow.

The name *Colletotrichum omnivorum* is proposed for this species by the author.

Other fungi affecting variegated plants (pp. 294, 295).—A list of 33 genera of plants and of fungi found on each.

Fungous diseases of various plants (pp. 296–304).—Notes on diseases of lupines, hollyhocks, chrysanthemums, orchids, hydrangeas, nasturtiums, violets, pansies, carnations, and roses.

A blue mildew (*Penicillium glaucum*) was observed on the roots of lupines growing at the Louisiana Station. Thus far this disease has not been found on lupines in New Jersey, but another fungous trouble has been discovered and is being studied.

Besides the diseases of the hollyhock mentioned in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 307), a second form of leaf spot (*Phyllosticta althæina*) has been observed.

The blight prevalent on the leaves of chrysanthemums was found to be due to a species of *Septoria*.

A disease of orchids was found to be due to a species of *Glœosporium*, which did not appear to be *G. cinctum* as its spores were twice as long as those of that species and not curved.

A blight due to *Phyllosticta hydrangeæ* has been observed on hydrangeas. "The fungus is spread by innumerable spores which are borne in minute pimples that nearly cover the brown patches of the leaf."

The foliage of the nasturtium was injured by a species of *Alternaria*. A form of anthracnose was also observed on plants of this kind.

An investigation of diseases of violets has been made and will be reported in a future bulletin of the station. The following diseases are mentioned: *Phyllosticta violæ*, *Marsonia violæ*, *Cercospora violæ*, *Ascohyta violæ*, *Colletotrichum* sp., *Glœosporium* sp., *Peronospora violeæ*, and *Zygodesmus albidus*.

"Outside of fungi, the red spider has been observed as doing considerable damage, but worse than this are the gall worms, mentioned in the last report (1890), which are responsible for much mischief done, but being out of sight are not easily detected."

Carnations have been found to suffer from the attacks of *Septoria dianthi*, a species of *Colletotrichum*, and a rust (*Uromyces caryophyllinus*). Sulphide of potassium 0.5 ounce to 1 gallon of water has been successfully used to prevent blight in a large greenhouse devoted to carnations.

Notes on treatment for fungi (pp. 304–310).—Practical suggestions regarding the treatment of various fungous diseases are collated in this article from reports in the publications of this Department and the stations, as follows:

Name of disease.	Publication.	Experiment Station Record.
Spot disease of cherry and currant (*Cylindrosporium padi*).	Iowa Station Bulletin No. 13	Vol. III, p. 217.
Pear and quince leaf blight (*Entomosporium maculatum*).	Delaware Station Bulletin No. 13	
Apple rust	Connecticut State Station Bulletin No 107.	Vol. II, p. 711.
Peach blight	Journal of Mycology, vol. VII, p. 36	Vol. III, p. 327.
Anthracnose of the raspberry (*Glœosporium venetum*).	Ohio Station Bulletin vol. IV, No. 6	Vol. III, p. 411.
Lettuce rot	Massachusetts State Station Bulletin No. 40.	Vol. III, p. 162.
Potato scab	North Dakota Station Bulletin No. 4	Vol. III, p. 619.
Potato rot (*Phytophthora infestans*)	Vermont Station Bulletin No. 24	Vol. III, p. 101.
Clover rust (*Uromyces trifolii*)	New York Cornell Station Bulletin No. 24.	Vol. II, p. 421.
Smuts	Kansas Station Bulletin No. 15	Vol. II, p. 638.
	Indiana Station Bulletin No. 35	Vol. II, p. 637.
	Ohio Station Bulletin vol. IV, No. 4	Vol. III, p. 243.

Nematodes as enemies to plants (pp. 310–313).—In addition to those plants mentioned in the Annual Report of the station for 1890 as being injured by nematodes, the following kinds were found to suffer from the

same trouble in 1891: Begonias, pelargoniums, salvias, zinnias, moonflowers, and ferns.

Fungi affecting truck and garden crops, G. McCarthy (*North Carolina Sta. Bul. No. 81, Apr. 21, 1892, pp. 25, figs. 9*).—The nature of fungi and the means for their repression are briefly discussed. Formulas are given for fungicides, and spraying apparatus is described and illustrated. Suggestions are given for the treatment of vegetables for the fungous diseases named in the list given below:

Beans for pod blight (*Glœosporium lindemuthianum*) and leaf spot (*Uromyces appendiculatus*), cabbages for blight (*Peronospora brassicæ* and *Cystopus candidus*) and club root (*Plasmodiophora brassicæ*), celery for blight (*Cercospora apii*), melons for blight, potatoes for rot (*Phytophthora infestans*), sweet potatoes for black rot, strawberries for leaf rust, and tomatoes for rot (*Macrosporium tomato* and *Cladosporum fulvum*).

Black knot of plum and cherry (*New York State Sta. Bul. No. 40, n. ser., Mar., 1892, pp. 25–31, figs. 7*).—Statements regarding the history and prevalence of *Plowrightia morbosa* in New York and an illustrated description of this fungus, with suggestions as to its repression.

Treatment of diseases of the grape, W. B. Alwood (*Virginia Sta. Bul. No. 15, Apr., 1892, pp. 31–43*).—Summarized statements regarding the preparation, cost, and use of fungicides for the black rot and other diseases of the grape. The following formula for Bordeaux mixture has been tested with good results in the work of the station: Copper sulphate 2 pounds, lime (fresh) 2.5 pounds, water 25 gallons. Another preparation, in which carbonate of soda 2.5 pounds was substituted for the lime, has proved satisfactory. The cost of either of these fungicides is calculated to be 9 cents per 25 gallons. Analyses by the station chemist confirm the results obtained elsewhere in showing that sprayed fruit is not unwholesome.

Analyses of sprayed grapes (*New York State Sta. Bul. No. 41, n. ser., Apr., 1892, pp. 56–58*).—Analyses of grapes from a vineyard at Marlboro, New York, which had been sprayed with copper compounds. The amount of copper found on the berries averaged $\frac{1}{120}$ grain per pound of fruit, and on the stem $\frac{1}{30}$ grain per pound of fruit and stems. "To get an amount of copper that would be regarded as serious if taken at one dose, one would need to eat not less than 3,000 pounds of grapes, skins included, or not less than 5,000 pounds including berries and stems."

Spraying with fungicides for potato blight (*New York State Sta. Bul. No. 41, n. ser., Apr., 1892, pp. 44–46*).—Notes and tabulated data for an experiment in which White Star potatoes were sprayed with Bordeaux mixture and ammoniacal carbonate of copper. Both fungicides were effective, but on the whole the Bordeaux mixture was the most satisfactory.

Analyses of copper compounds (*New York State Sta. Bul. No. 41,*

n. ser., Apr., 1892, pp. 47–56).—A report on analyses of copper sulphate in three different forms, copper carbonate in two forms, Copperdine (dry and in solution), and "prepared Bordeaux mixture." The results showed the necessity for care in the purchase of such compounds and that home mixing is likely to be relatively economical.

ENTOMOLOGY.

Report of entomologist of New Jersey Stations, J. B. SMITH (*New Jersey Stas. Report for 1891, pp. 341–426, figs. 23*).

Synopsis.—This contains a general review of the work of the year, and notes on the rose chafer, insects injurious to the blackberry, squash borer, corn bill bug, pear midge, cranberry grasshoppers, Angoumois grain moth, and plum curculio; there is also an article on farm practice to control insect injury.

The rose chafer (pp. 350–372).—Notes on *Macrodactylus subspinosus* reprinted from Bulletin No. 82 of the station (E. S. R., vol. III, p. 169).

Insects injurious to the blackberry (pp. 372–385).—A reprint of Special Bulletin N of the station (E. S. R., vol. III, p. 705).

The squash borer (pp. 385–394).—In the Annual Report of the station for 1890 (E. S. R., vol. III, p. 309) information was given regarding the squash borer (*Melittia ceto*). The present report contains an account of observations made in 1891 with a view to finding a means of repressing this pest. June 26 the eggs of the borer were observed on the vines of Hubbard squashes. At first the eggs were laid very close to the surface of the ground, but later in the season further along at the joints, 6 or 8 feet from the base. "Under the microscope the eggs show a very finely shagreened surface with slightly raised lines forming hexagonal figures. The shell is thick and chitinous, but very brittle and readily broken."

Treating the eggs with kerosene emulsion did not prevent the development of the larvæ. July 2 the author again examined the vines.

None of the eggs were yet hatched and they were in still greater number than before. On eleven hills of Hubbard squashes, rubbed the stem on all sides with thumb and finger from the surface to and around the base of the first large leaf, using a little earth to get a rougher friction, which would be more certain also to get into crevices or hollows where eggs might be concealed. The object was of course to crush the eggs, and this was thoroughly accomplished in almost every case. The rubbing extended to a little below the surface, and the work was quickly and easily done. On another hill the plants were carefully removed and all the eggs were separately crushed. The plants were at once reset; but though there was a slight rain at the time and the plants were watered next day, they did not start again for a long time and never amounted to anything. * * *

On July 7 I found the moths still flying. Three specimens were taken, evidently fresh and probably recently out of the pupa. On the tenth I examined several of the vines and found more eggs, one of them just hatched. The latter had evidently escaped the rubbing; the others were probably later and were somewhat further from the base. On the eleventh the last eggs in my possession hatched, giving a

period for this stage of about fifteen days, assuming that of those collected by me on June 25 some had been laid on that day and that those had been the last to hatch. None of the eggs had a period of less than ten days, and assuming fifteen days to be normal those that first hatched must have been laid about June 20. It will be safe to say, I think, that the moths begin to make their appearance about June 18 and continue to about the same date in July. None were observed in Mr. Marshall's patch after July 10, but I had caught several, and I have been informed by entomologists that they had taken the species as late as the twentieth. Dr. D. S. Kellicott of the State University at Columbus, Ohio, informed me that he captured an apparently fresh specimen the latter part of August. This indicates a double brood, and does not agree with the general habit of the insect in New Jersey. These observations would extend the period of hatching from July 6 to July 30 at least and probably to August 5, and would make a difference of about a month between the oldest and youngest larva. This is borne out by what is observed in the vines.

Before the middle of July the squash vines were rubbed a second time and covered at the joints to facilitate rooting. The experiment was so far successful that the vines grew to large size and produced an abundant crop.

"Two points may be considered proved, (1) that rubbing the stem of the vines from base to and around the first large leaf will destroy the early-laid eggs; (2) that the vine is able to maintain its own vigor and mature fruit from joint roots even where it is entirely severed at the base."

The corn bill bug (pp. 394–396).—Brief notes on injuries by *Sphenophorus sculptilis* at various places in New Jersey and suggestions as to remedies.

The pear midge (pp. 397–402).—Notes on the life history, migration, and treatment of *Diplosis pyrivora*, which seems to be spreading rapidly in New Jersey.

Cranberry grasshoppers (pp. 402–405).—In view of the fact that cranberry growers are very positive that grasshoppers and crickets are injurious to cranberries, the author gives a brief account of the life history of the red-legged grasshopper (*Melanoplus femur-rubrum*) and the differential grasshopper (*M. differentialis*), with suggestions as to remedies.

The Angoumois grain moth (pp. 405–408).—A brief description of *Gelechia cerealella*, with suggestions as to remedies. This insect was reported as infesting wheat in New Jersey in 1891.

Farm practice and fertilizers to control insect injury (pp. 409–420).—A reprint of Bulletin No. 85 of the station (E. S. R., vol. III, p. 610).

The plum curculio (pp. 420–423).—Brief accounts of experiments by the author and others with kerosene emulsion. In only one case was this treatment reported to have been successful.

Insecticide machinery (pp. 423, 424).—A long lance for knapsack sprayers with a Vermorel nozzle is described. "It is intended for underspraying low plants like cabbages or the leaves of melon or similar vines. It is indispensable to truckers and by its means such pests as the melon louse or cabbage louse can be easily and certainly reached.

The force of the spray from such an apparatus is great enough to penetrate into the curled leaves and to reach every insect in every fold, while very little liquid is wasted or applied where not needed."

Miscellaneous notes (pp. 421–426).—Brief statements regarding the treatment of the horn fly, citron and melon lice, cabbage worm, and peach borer.

Observations on injurious insects, 1891, C. P. GILLETTE (*Colorado Sta. Bul. No. 19, May, 1892, pp. 32, figs. 12*).—Notes on the following insects, with accounts of observations by the author and suggestions regarding remedies: Fruit tree leaf roller (*Cacœcia argyrospila*), box elder leaf roller (*C. semiferana*), grapevine leaf roller (*Typhlocyba vitifex* ?), gooseberry fruit fly (*Trypeta canadensis*) imported currant borer (*Sesia tipuliformis*), Western currant and gooseberry spanworms (*Thamnonoma 4-linearia* and *T. flavicaria*), spotted bean beetle (*Epilachna corrupta*), squash root maggot (*Cyrtonema stabulans* ?), and pea weevil (*Bruchus pisi*).

Insects affecting truck and garden crops, G. MCCARTHY (*North Carolina Sta. Bul. No. 84, Apr. 21, 1892, pp. 25, figs. 23*).—Formulas are given for insecticides and suggestions are made for the repression of the following insects: Cutworms, cabbage worms (*Pieris rapæ* and *P. oleraceæ*), terrapin bug (*Murgantia histrionica*), flea beetle (*Graptodera* sp.), cabbage louse (*Aphis brassicæ*), squash bug (*Anasa tristis*), striped cucumber beetle (*Diabrotica vittata*), Colorado beetle (*Doryphora decemlineata*), black blister beetle (*Cantharis nuttalli*), and tortoise beetle (*Cassida bivittata*). There are also brief accounts of the following beneficial insects: Nine-spotted ladybug (*Coccinella novempunctata*), ten-spotted ladybug (*Hippodamia maculata*), convergent ladybug (*Hippodamia convergens*), fiery ground beetle (*Calosoma calidum*), green ground beetle (*Calosoma scrutator*), murky ground beetle (*Harpalus caliginosus*), Virginia tiger beetle (*Tetracha virginica*), elongated ground beetle (*Pasimachus elongatus*), banded soldier bug (*Milyas cinctus*), thick-thighed soldier bug (*Acanthocephala femorata*), and dragon fly (*Libelula trimaculata*).

Notes on insects, E. S. RICHMAN (*Utah Sta. Bul. No. 11, June 1, 1892, pp. 7–11, figs. 7*).—Accounts of the cabbage plant louse (*Aphis brassicæ*) and its enemies, and of the flea beetle (*Epitrix crinita*), with suggestions regarding remedies. In the author's experiments kerosene emulsion has proved the most efficient remedy for these insects.

Analyses of insecticides (*Massachusetts State Sta. Report for 1891, p. 339*).—Analyses of Paris green, tobacco liquor, and Dalmatian insect powder, made in 1891, and a compilation of analyses of various insecticides.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor*.

Food investigations, W. O. ATWATER and C. D. WOODS (*Connecticut Storrs Sta. Report for 1891, pp. 41–171*).

Synopsis.—The account of these investigations includes introductory statements and chapters on the composition of food materials, a study of dietaries and dietary standards, methods of food investigation, and the economic application of results of studies of food and dietaries. The conclusion is reached that dietaries and food production in this country are out of balance. Too much carbohydrates and fat are produced and consumed and too little protein. A résumé of some of these investigations was given in Bulletin No. 7 of the station (E. S. R., vol. III, p. 213).

Composition of food materials (pp. 46–90).—A brief description of the methods of analysis employed, and analyses of the following food materials: Separate portions of a side of beef, of mutton, and of lamb; miscellaneous cuts and pieces of fresh and preserved beef, mutton, veal and pork; sausage, poultry, hens' eggs, a large number of different kinds of fresh and preserved fish, shell fish, etc.; various animal organs (liver, heart, gizzard, lungs, kidney, tongue, tripe, and beef marrow); wheat, graham, and rye bread; crackers, oatmeal, buckwheat flour, farina, and groats; starch, sugar, molasses, milk, butter, cheese, and oleomargarine; canned corn, canned peas, and canned tomatoes; potatoes, sweet potatoes, beets, turnips, carrots, onions, squash, pumpkin, cucumber, cabbage, cauliflower, lettuce, spinach, rhubarb stems, asparagus, tomatoes, green peas, string beans, Lima beans, okra, green sweet corn, eggplant, apples (flesh), pears, cherries (flesh), strawberries, blackberries, whortleberries, cranberries, Catawba grapes, lemons, oranges, banana (pulp), pineapple, watermelon (flesh or pulp), nutmeg melon (flesh or pulp), rice, dried beans, corn meal, white hominy, pearl barley, and rye flour. The analyses are of the edible portion, but the percentage of refuse or waste is usually given. These data are given in detail and compiled in tables showing the maximum, minimum, and average composition. Many of the analyses of vegetables are from Jenkins and Winton's Compilation of Feeding Stuffs published by this Office.

A study of dietaries (pp. 90–106).—Two studies of dietaries were made, one of a boarding house where 13 men and 8 women boarded, and the other of a private family of 5 persons. In both cases the observations extended over one month. Weights were taken of all food materials purchased and of the waste, and in the case of the boarding house samples of the food purchased and of that thrown away were taken for analysis. From the analyses in the latter case and from average analyses in the other, calculations were made of the total amounts and

potential energy of nutrients consumed. These data are fully tabulated.

[In the case of the boarding house,] about one ninth of the total nutritive ingredients of the food was left in the kitchen and table waste. The actual waste was worse than this proportion would imply, because it consisted mostly of the protein and fats, which are more costly than the carbohydrates. The waste contained nearly one fifth of the total protein and fat and only one twentieth of the total carbohydrates of the food. Or, to put it in another way, the food purchased contained about 23 per cent more protein, 24 per cent more fats, and 6 per cent more carbohydrates than were eaten. And, worst of all, for the pecuniary economy or lack of economy, wasted protein and fats were mostly from the meats which supply them in the costliest form. At the ratio in which the nutrients were actually eaten in this dietary the protein in the waste would have sufficed one man for one hundred and twelve days; the fats would have supplied him also for one hundred and twelve days, and the carbohydrates for thirty days. * * *

[Suggestions are given regarding home study of dietaries.] While it may be impracticable to bring our daily ration to accord very closely with a standard dietary, it is practicable to see if in our eating we are varying very greatly from this standard. If the kinds and amounts of food eaten during a given period, as a week or a month, be recorded, from these data it will be quite easy to calculate the pounds or grams of protein, fats, and carbohydrates that have been used, and in this way we can learn how our actual dietaries vary from what they should be. It is of course easy to devise a simple ration which should give exactly what the different standards call for, but in practice this is not feasible, since we use so many kinds of foods. The American standard for a man at moderate work calls for 125 grams (0.276 pound) of protein, 125 grams (0.276 pound) of fat, and 450 grams (0.992 pound) of carbohydrates per day. This would be approximately furnished by 10 ounces of lean beef (free from bone), 20 ounces of bread, 25 ounces of potatoes, and 4 ounces of butter; but such a simple ration as this would not serve for ordinary purposes.

American and European dietaries (pp. 106–161).—In connection with the Massachusetts Bureau of Statistics of Labor, a series of studies was made in 1886 of the quantities of food constituents used in somewhat over thirty dietaries of working people in Massachussetts and Canada. At the same time and later some half dozen dietaries of college students and other people in Middletown were examined. During the past year studies in the same direction, but by more detailed and thorough methods, have been carried on in connection with the United States Department of Labor.

The results of these studies and of comparisons with the results of investigations in Europe and with European dietary standards, are fully tabulated and discussed.

To compare the food statistics of French Canadians in Canada and in Massachusetts with each other and with those of laborers of other nationalities in Massachusetts, studies were made in connection with the Massachusetts Bureau of Statistics of Labor, of the dietaries of thirteen families and boarding houses of French Canadians at home, of seven of French Canadians in Massachusetts, and of ten of laboring people, mostly operatives in mills and factories in Lowell, Lynn, East Cambridge, and Boston. The classes represented in each case were laborers with "only very moderate incomes, and the majority were factory

operatives." The following is the outcome of these studies, and is from the Report of the Bureau for 1886:

It appears that the French Canadian laboring man whose food we have examined consumes at home 3½ pounds of food (including milk) per day. But when he comes to Massachusetts and works in a factory or engages in other manual labor, he consumes 5 pounds, while other laborers, factory operatives, mechanics, etc., in Massachusetts, whose dietaries have been examined, consume 5½ pounds of food per man per day. The food of the French Canadian at home costs 14 cents, but in Massachusetts he expends 24 cents, while the food of the other Massachusetts laborers costs 25 cents per day. The nutrients in the food materials show corresponding gradations, the Canadian having 109 grams of protein per day at home and 118 in Massachusetts, while the other Massachusetts laborers have 127 grams. The gradations in the carbohydrates are similar, save that the differences are smaller. The amount of fats is smallest in the dietary of the Canadian in Canada, but nearly the same in that of the Canadian and other laborers in Massachusetts. That the Canadian in Massachusetts should have more fat than other laborers, while he has so much less protein, is apparently due to the larger proportion of salt pork in his meat.

A most interesting fact set forth is found in the proportions of animal and vegetable food. In Canada the French Canadian has 1 pound of animal food—meats, fish, milk, butter, cheese, eggs, etc.; in Massachusetts he has 1¼ pounds, while his fellow-laborers of other nationalities have 2¼ pounds per man per day. There is a corresponding variation in the proportion of animal protein to the total protein of the food, the French Canadian at home having 37 per cent, the same man in Massachusetts 46 per cent, and other Massachusetts laborers 57 per cent.

These figures are the expression of what we suppose to be a general law, namely, that where the conditions of life are otherwise approximately similar, as in the different countries of Europe and America, not only the total amount of food, but more especially the amount of meat and other animal food consumed increase with the revenue of the consumer.

An examination of the dietary of a Boston boarding house whose boarders were mostly teamsters and marble workers, men at quite severe labor who received good wages, showed the following quantities of nutrients per man per day: Protein 254 grams, fats 363 grams, and carbohydrates 826 grams. The potential energy of the diet is 7,805 Calories.

The dietary of brickmakers in Middletown was found to contain per man per day, protein 222 grams, fats 263 grams, carbohydrates 758 grams, equivalent to a potential energy of 6,460 Calories.

A summary of these and other figures for students' boarding clubs, professional men, army and navy rations, etc., together with dietary standards, has already been given in the Record (vol. III, p. 214). These dietaries are shown to be much more liberal than the European dietary standards, which provide for from 118 to 130 grams of protein and from 3,030 to 3,160 Calories of energy, and to furnish larger amounts of food than the dietaries of people in corresponding conditions of life in Europe.

To these there is another consideration to be added, though the statistics of production do not yet suffice for its exact numerical expression. It is that the better-fed wage workers in Massachusetts and Connecticut do more work than those with like callings but inferior nourishment in Saxony and Bavaria.

Within a short time past I have had occasion to learn somewhat more than before

of the condition of wage workers in Saxony, and have been surprised and pained anew by the condition in which they live and work. The scantily-fed—those who live upon the nutritive plane expressed in the smaller European dietaries, with from only 50 to 80 grams of protein, and from 1,800 to 2,800 Calories of energy—are sadly numerous. Large bodies of the most industriously disposed working people in the country, including many operatives in manufacturing establishments whose products are exported to the United States, live on what to us would seem almost the border land of starvation. * * *

Unquestionably we eat a great deal more than we need, but it would be very hard to believe that food with 3,055 Calories of potential energy per day, which Voit's standard for a man of moderate muscular work calls for, would suffice for men who live and work and earn wages as do the laboring people in Massachusetts and Connecticut, the heat and strength-giving energy of whose food, including that which is so lavishly wasted, is estimated at from 4,400 to 4,660 Calories per day.

[The author urges that the European dietary standards] do not represent the quantities of nutritive material that the average mechanic or other working man needs in order to do a fair day's work; that the allowance is too small for what such a man ought to do and can well do. * * * The kernel of the whole question is found in the fact that the European standards are based upon the food consumption of people whose plane of living is low in comparison with that of the people in the United States. The thesis which I attempt to defend is that to make the most out of a man, to bring him up to the desirable level of productive capacity, to enable him to live as a man ought to live, he must be better fed than he would be by these standards. This is only part of the story, but it is an essential part. The principle is one that reaches very deep into the philosophy of human living. * * * Let us take for instance the case of an average man—say a carpenter, blacksmith, or day laborer—who is doing a moderate amount of muscular work. To make up for the constant wear and tear of muscle, tendon, and other nitrogenous tissue, he must have protein. To use his muscle, strength, *i. e.*, muscular energy, is required. Furthermore, his body must be kept warm. These two kinds of energy, muscular energy and heat, his body gets by transforming the potential energy of either protein, fats, or carbohydrates. The most of the energy is supplied by the fats and carbohydrates, but some comes from protein. Our workingman then needs in his daily food (1) enough of protein to make up for the protein of muscle and other nitrogenous tissue consumed in his body; (2) enough energy to supply the demand for heat and muscular work.

The problem then is this: How much protein, fats, and carbohydrates does the average man, with a moderate amount of work to do, require in a day's food?

In the following table I venture to suggest certain proportions of protein and energy which may be appropriate as averages for dietaries for people of different forms of activity.

It has been assumed that a woman requires on the average eight tenths as much as a man for corresponding muscular activity:

Standards for daily dietaries of adults.

No.		Protein.	Potential energy.
		Grams.	*Calories.*
1	Man with very little physical exercise or women with light work	90	2,500
2	Man with light or woman with moderate work	100	3,000
3	Man with moderate muscular work	125	3,500
4	Man with active muscular work	150	4,000
5	Man with severe muscular work	175	5,700
6	Man with very severe muscular work	200	7,500

Methods of food investigation (pp. 161-163).—Short remarks on improvement of methods of analysis, studies of the digestibility and the functions of food in nutrition, studies of dietaries, etc.

Economic applications of results of studies of food and dietaries (pp. 164-171).

Food constitutes the chief item of the living expenses of the people and of our agricultural production and one of the most important of our exports to Europe.

Wage workers and people of moderate incomes generally in New England spend and must spend nearly half their earnings for food. Although "half the struggle for life is a struggle for food," and although the health and strength of all are so intimately connected with and dependent upon their diet, yet even the most intelligent people know less of the actual uses and values of their food for fulfilling its purposes than of those of almost any other of the necessities of life.

The lack of information regarding the nutritive values and proper uses of food results in great waste in the purchase and use of food, loss of money, and injury to health. * * *

We make a threefold mistake in our food economy. First, we purchase needlessly expensive kinds of food. The cheapest food is that which supplies the most nutriment for the least money. The most economical food is that which is the cheapest and at the same time the best adapted to the wants of the user. The maxim that "the best is the cheapest" does not apply to food. * * *

Second, the food which we eat does not always contain the proper proportions of the different kinds of nutritive ingredients. We consume fats and carbohydrates in relative excess. * * *

The quantities of fat in the European dietaries range from 1 to 5 ounces per day, while in the American the range is from 4 to 16 ounces. In the daily food of the well-to-do professional men in Germany, who are amply nourished, the quantity of fat is from 3 to 4½ ounces. The quantities of carbohydrates in the European dietaries range from 9 to 24 ounces, while in corresponding American dietaries they are from 24 to 60 ounces. People in this country eat what is set before them, asking no questions for economy's sake, provided it suits their taste. We are a generation of fat and sugar eaters. We are so because of the abundance and toothsomeness of foods containing fat and sugar.

Third, in this country many people (not only the well-to-do, but those in moderate circumstances also) use a needless quantity of food. Part of this excess, however, is simply thrown away, so that the injury to health, great as it may be, is doubtless much less than if all were eaten. * * *

Allowing that the food consumption of which statistics have been collated is approximately representative of that of people in the United States generally, we are led to the conclusion that our national dietary has become one-sided, so that although we live upon a high nutritive plane, our food might be better fitted to our needs. * * *

The one-sidedness of our dietary is the result of the one-sidedness of our agricultural productions. The agricultural production of the United States is out of balance. Our food supply for man and beast contains an excess of the materials which serve the body for fuel and are relatively deficient in the nitrogenous compounds which make blood, muscle, and bone. In other words, the farmer produces relatively too much starch, sugar, and other carbohydrates; too much fat and too little protein. The crops he grows are, taken together, deficient in protein, and the meat he makes is excessively fat. The one-sidedness of our food consumption is the natural result of the one-sidedness of our food production. * * *

As the farmer is primarily responsible for this state of affairs and the first loser by it, so he must be the one to take the first step to amend it. The remedy for the evil is to grow crops with more protein. The needed increase of protein may be

obtained by breeding and importing varieties of grains and grasses richer in nitrogen than those we now cultivate, and by growing more legumes, such as clovers, alfalfa, vetch, serradella, cowpeas, peas, and beans.

The value of nitrogenous feeding stuffs is not sufficiently appreciated, but the progress of exact experiment in this country and in Europe is bringing it out more and more clearly.

Analyses of foods and feeding stuffs (*Massachusetts State Sta. Report for 1891, pp. 297–300, 313–326*).—Tabulated analyses of sugar beets, vinegar, and baking powder, and a compilation of analyses of salt and of miscellaneous feeding stuffs.

Analyses of commercial feeds (*New Jersey Stas. Report for 1891, pp. 145–175*).—A reprint of Bulletin No. 87 of the station (E. S. R., vol. III, p. 878). To this is added an explanation of the method of forming the coefficients of the normal equations by successive substitution in the calculation of the cost per pound of protein, fat, and carbohydrates in feeding stuffs from the selling price by the method of least squares.

Some general remarks on analysis of fodder and fodder analyses, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1891, pp. 86–106*).—Popular remarks on food ingredients and the principles of feeding, manurial value of feeding stuffs, valuation of feeding stuffs, and analyses of the following materials: Corn meal, wheat middlings, bran from spring and winter wheat, Chicago maize feed, brewers' grains, old and new-process linseed meal, gluten meal, cotton-seed meal, corn-and-cob meal, hominy chops, ground barley, cocoanut meal, hog feed, bakery refuse, hay from salt meadows, English hay, rowen, corn stover, corn silage, mangel-wurzels, and sugar beets. The methods used in the analysis of cattle foods are briefly described.

Feeding experiments with milch cows, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1891, pp. 14–106*).

Synopsis.—These experiments include comparisons of old-process linseed meal with gluten meal; of gluten meal, cotton-seed meal, and old-process linseed meal; a trial of green vetch and oats, soja beans, and fodder corn for soiling; and the creamery record of the station for 1890 and 1891. The nutritive effect of the gluten meal was found to be slightly higher than that of an equal weight of linseed meal. The creamery record shows the average net cost of food per quart of cream to have been 6.1 cents in 1890 and 5.24 cents in 1891, and the receipts from the creamery 11.8 cents per quart in 1890 and 12.61 cents in 1891.

Old-process linseed meal vs. gluten meal (pp. 15–30).—Old-process linseed meal and gluten meal were compared in an experiment with six grade cows lasting from October 21 to December 31, 1889. The time was divided into three periods of equal length. In the first and second periods 3¼ pounds of gluten meal and in the third period 3¼ pounds of old-process linseed meal were fed per day in connection with 3¼ pounds each of corn meal and wheat bran, and hay *ad libitum*. The grain was fed dry. The amount of hay eaten ranged from 18 to 20 pounds per day. The tabulated data include analyses of the feeding stuffs used with reference to both food and fertilizing ingredients; analyses of milk; and statements of the live weights of the animals,

the food consumed, milk yield, and calculations of the gross and net cost of the food. The cost of food is based on the local market prices—corn meal $19, wheat bran $17.50, gluten meal $23, linseed meal $27, and hay $15 per ton. On this basis the gross cost of the gluten meal ration was 24.3 cents per day and of the linseed meal ration 24.18 cents. Assuming 80 per cent of the fertilizing ingredients in the food to be obtainable in the manure, "the higher market price of the old-process linseed meal, $4 per ton, is practically offset by the higher commercial value of the manurial refuse obtained." Making this allowance for the value of the fertilizing ingredients, the cost of the linseed meal ration is calculated at 14.64 cents per day and of the gluten meal ration 14.06 cents. The average daily yield of milk by each cow in the different periods is given as follows:

Average yield of milk per day.

Feeding periods.	Juno.	Flora.	Eva.	Elsie.	Jessie.	Annie.
	Quarts.	*Quarts.*	*Quarts.*	*Quarts.*	*Quarts.*	*Quarts.*
(1) Oct. 21–Nov. 10, 1889	11.63	9.87	7.37	7.70	8.37	8.06
(2) Nov. 13–Dec. 3, 1889	11.27	9.11	7.14	7.42	8.23	7.55
(3) Dec. 11–31, 1889	9.67	8.64	6.28	7.07	7.87	6.90
Average	10.85	9.21	7.27	7.39	8.16	7.50

The average net cost of food per quart of milk was 1.66 cents in the first period, 1.76 cents in the second period, and 1.85 cents in the third period. The following are the author's conclusions:

(1) The substitution of 3¼ pounds of Chicago gluten meal by the same weight of old-process linseed meal at local market prices raises the market cost of the daily ration 0.65 cent per head. Taking the manurial value into consideration, the old-process linseed meal proves 0.04 cent cheaper than gluten meal. The higher manurial value of the linseed meal as compared with the gluten meal fairly equals the difference in the local market cost.

(2) In our case gluten meal leads the old-process linseed meal in every instance as far as the nutritive effect is concerned. The difference is not great, yet worthy of special notice under stated market conditions.

(3) The quality of the milk as far as its density is concerned shows no marked difference during the entire experiment.

Comparison of gluten meal, cotton-seed meal, and old-process linseed meal (pp. 31–59).—An account of this experiment was given in Bulletin No. 41 of the station (E. S. R., vol. III, p. 287).

Feeding trial with green crops (pp. 59–73).—This experiment was in continuation of trials in previous years to study the feeding value and the economy of green fodder crops in dairy farming. The crops used were green vetch and oats, soja beans, and fodder corn. Five grade cows were fed from July 6 to September 26, 1891. The vetch and oats and soja beans were cut from the beginning of blooming until they were fully matured but still succulent, and the green fodder corn was cut when the kernels were fully developed but still milky. The grain con-

sisted of 3 pounds of corn meal and 3 pounds of gluten meal, with either 3 pounds of wheat bran or 3 pounds of dried brewers' grains per day. This was fed with 5 pounds per head of rowen hay and the green crops *ad libitum*, the amount of the latter consumed ranging from 37 to 50 pounds per day. Vetch and oats and the soja bean were each fed, in separate periods, with dried brewers' grains and with wheat bran, and the fodder corn was fed with brewers' grains. Analyses are given of the corn meal, gluten meal, brewers' grains, wheat bran, vetch and oats, soja beans, and fodder corn, with reference to both food and fertilizing ingredients; and the yields and analyses of milk, amount of fodder consumed, and the net cost of milk per quart are tabulated for each cow.

The results of the past season obtained in this connection are very encouraging when compared with those noticed in preceding years.

(1) The yield of milk is well maintained during the entire experiment of three months. The average daily yield of milk of the various cows for the entire experiment is in four out of five cases larger than their yield at the beginning of the observation; in the fifth case there is practically no change. The largest average yield of milk was noticed, without any exception, in case of soja beans as green fodder and dried brewers' grains as an ingredient of the daily grain feed ration. Green fodder corn leads the green vetch and oats with dried brewers' grains in three out of five cases.

(2) The amount of dry vegetable matter consumed per quart of milk produced varies in case of different cows from 1.77 to 3.33 pounds. * * *

(3) [The average net cost of food per quart of milk was as follows: Vetch and oats with brewers' grains, 1.35 cents; with wheat bran, 1.26 cents; soja beans with brewers' grains, 1.58 cents; with wheat bran, 1.7 cents; fodder corn with brewers' grains, 1.88 cents.]

(4) The value of the obtainable manure amounts on an average to three sevenths of the market cost of the feed consumed. The green vetch and oats leads in this connection.

(5) The quality of the milk is in every instance improved in the percentage of solids during the experiment without showing any perceptible decrease in yield.

(6) Brewers' grains has served as an excellent substitute for wheat bran in our diet for milch cows.

Creamery record for 1890 and 1891 (pp. 73–86).—This comprises tabular statements of the kinds and amounts of food consumed by the station herd in 1890 and 1891; the quantity of milk produced, arranged by months; the local market prices of the feeding stuffs used; the valuation of the fertilizing ingredients in the same; the amounts received for the cream at the creamery; and the cost of skim milk with whole milk at 3 cents per quart. To this are added analyses of the cream during each month of 1891, the average fertilizing constituents in cream, and a brief description of the methods used in the analysis of milk and of butter.

From these statements it appears, as has already been claimed in previous reports, that close fodder rations tend to improve the quality of the milk as well as the condition of the animal. The introduction of dried brewers' grains and cotton-seed meal into the daily diet has apparently lowered to a considerable extent the net cost of feed.

For further details concerning results in preceding years, see Seventh Annual Report, pp. 82–84 [E. S. R., vol. II, p. 576], and Eighth Annual Report, pp. 54–65 [E. S. R., vol. III, p. 154]. * * *

The total cost of feed for 1 quart of cream amounted in 1890 to 14.12 cents, and in 1891 to 12.83 cents. * * *

The net cost of feed per quart of cream averaged in 1890, 6.1 cents, and in 1891, 5.24 cents. We received per quart of cream in 1890, 11.80 cents, and in 1891, 12.61 cents, thereby securing a profit of 5.7 cents per quart in 1890 and 7.37 cents in 1891.

The number of quarts of milk required to produce 1 quart of cream was 5.47 in 1890 and 5.78 in 1891. There was received, therefore, 2.16 cents per quart of milk in 1890 and 2.18 cents in 1891.

Feeding experiments with steers, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1891, pp. 107–127*).—An account of this experiment with yearling and 2-year-old steers was given in Bulletin No. 40 of the station (E. S. R., vol. III, p. 162).

Feeding experiments with lambs, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1891, pp. 128–147*).—The object of this experiment was to study the effect of different feeding stuffs on the cost of fattening lambs during the winter. A previous experiment on the same subject was reported in Bulletin No. 37 of the station (E. S. R., vol. II, p. 231).

"The selection of animals was made from the temporary supply of our local market. Six lambs, wethers, grades of uncertain parentage, served for the trial; they were shorn before being weighed at the beginning of the observation. Each animal occupied a separate pen during the entire experiment."

The experiment lasted from September 30, 1890, to April 20, 1891—202 days. This time was divided into four periods, separated by intervening periods of 8 days each, the first period lasting 14 days, the second 98 days, the third 34 days, and the fourth 41 days. During the first period the lambs all received the same food (wheat bran, linseed meal, and rye). At the close of this time they were divided as nearly equally as possible into two lots, A and B. Lot A received throughout the trial a grain mixture consisting of ten parts by weight of corn meal, two parts of wheat bran, and one part of gluten meal, and lot B received a mixture of two parts by weight of wheat bran and one part of gluten meal, 8 ounces of each grain mixture being fed per day, in connection with 1 pound of rowen, or one third pound of rowen and corn silage *ad libitum*. The nutritive ratio of the rations of lot A was 1:6.5–7.4, and of lot B 1:4.5–5. The lambs were purchased at the beginning of the trial for 5 cents per pound and ranged in weight from 50 to 64 pounds. Deducting the amount received for the wool, the average cost after shearing was 3.98 cents per pound. At the close of the experiment the animals were sold at 11 cents per pound dressed weight, the wool at 25 cents per pound, and the pelts at 12½ cents each.

Analyses are given of the feeding stuffs used, with reference to both food and fertilizing ingredients, and data as to the food consumed, cost of rations, gains in live weight, etc., are tabulated. On an average lot A gained 45.33 pounds each during the experiment, and lot B 41.33

pounds. The three lambs in lot A produced 1 pound more wool than lot B. The cost of the feeding stuffs was, corn meal $28, wheat bran $25, linseed meal $26, gluten meal $28, corn silage $2.75, and rowen $15 per ton. The financial results were as follows:

	Lot A.	Lot B.
Cost of lambs and feed	$20.58	$20.86
Value of meat, wool, pelts, and obtainable manure	25.07	26.14
Apparent profit	4.49	5.28

In calculating the value of the manurial ingredients, 20 per cent was deducted from those contained in the feeding stuffs.

"The value of the obtainable manure, amounting to from $10 to $11 for the entire operation, represents the profits of the experiment, aside from disposing of our home-raised fodder articles at a liberal retail market price."

Feeding experiments with pigs, C. A. Goessmann (*Massachusetts State Sta. Report for 1891, pp. 148–170*).—Three experiments are reported which were made to compare the cost of producing pork in the case of different breeds. Small Yorkshires, Berkshires, Poland-Chinas, and Tamworths, from 2 to 3 pigs of each breed, were used in each trial. The pigs ranged in weight from 20 to 50 pounds at the beginning of the trial. They were all thoroughbreds. The food consisted of buttermilk, skim milk, corn meal, wheat bran, and gluten meal, in such proportions as to furnish a nutritive ratio of 1:2.8 when the animals weighed from 20 to 90 pounds, 1:3.8 from 90 to 130 pounds, and 1:4.36 from 140 to 200 pounds. The amount of food consumed was governed by the individual appetites.

The first experiment lasted from May 13 to October 15, 1890; the second from November 18, 1890, to April 19, 1891; the third from May 12 to September 7, 1891. The results of the first two experiments are briefly summarized, and those of the third experiment are given in more detail, showing the amounts of food consumed by each pig, the live weight, the cost of food per pound of live weight and dressed weight, the value of the manure, data obtained at time of killing, and analyses of the corn meal, wheat bran, gluten meal, buttermilk, and skim milk used in the experiment.

The following statement summarizes the cost of food for the production of 1 pound of dressed pork, based on the ruling market prices of the feeding stuffs at the time they were used. These prices ranged as follows: Corn meal $24 to $31 per ton, wheat bran $19 to $23, gluten meal $25 to $27, skim milk 1.8 cents per gallon, and buttermilk 1 cent per gallon.

Cost of food per pound of pork.

Breed.	Experiment 1.			Experiment 2.			Experiment 3.		
	Total cost.	Net cost.	Obtainable manurial value.	Total cost.	Net cost.	Obtainable manurial value.	Total cost.	Net cost.	Obtainable manurial value.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Small Yorkshire	4.79	3.14	1.65	5.68	4.14	1.54	6.36	4.86	1.50
Berkshire	4.80	3.13	1.67	5.20	3.74	1.46	6.07	4.59	1.48
Poland-China	4.57	2.98	1.59	5.50	4.00	1.50	5.79	4.40	1.39
Tamworth	4.52	2.97	1.65	......	......	....	6.33	4.78	1.55

Concerning the amount of dry matter consumed per pound of dressed pork, "it appears that in our case the larger-built breeds led the smaller breeds in two out of three experiments. The difference between breeds is apparently no more marked than the difference between animals of the same breed." The average gain per day in live weight was slightly larger in the case of the Poland-China and Tamworth breeds, which "show practically no difference in that respect."

A comparison of the digestibility of corn silage and corn stover in feeding rations, and of their effects upon the consumption of albuminoids, H. J. PATTERSON (*Maryland Sta. Report for 1891, pp. 309–346*).

Synopsis.—A feeding experiment with four steers during three short periods, with preliminary or intermediate periods of varying length, to test the digestibility of corn silage *vs.* stover combined with meal, and the effect of the rations on the production of lean meat. The silage proved to be slightly more digestible than the stover. The production of lean meat was somewhat less with the silage ration. This is attributed to the acids in the silage.

The questions proposed were: "Do the acids of silage aid or retard digestion? Do they cause an increased consumption of albuminoids and consequently a loss in flesh?" Four Hereford steers, two yearlings and two two-year-olds, were used in the experiment. These were divided into two lots, each lot containing one animal of each age. The lots were fed during three periods of five days each, with preliminary or intermediate periods of from nine to twenty-six days, as follows:

Lot 1:
- Period 1, corn stover, corn meal, cotton-seed meal.
- Period 2, corn silage, corn meal, cotton-seed meal.
- Period 3, corn silage, corn meal.

Lot 2:
- Period 1, corn silage, gluten meal, germ feed.
- Period 2, corn stover, gluten meal, germ feed.
- Period 3, corn stover, gluten meal, wheat bran.

The amounts of coarse food given were varied more or less according to the appetites of the animals. The average consumption of silage ranged from 13.5 to 25 pounds per animal daily, and of corn stover from 3 to 8 pounds. The silage and stover were both of good quality, but they were not made from the same corn. The stover was from corn that

had been topped and was cured under cover. Samples were taken of the different feeding stuffs as they were weighed out, and from the mixed samples portions were taken for analysis. The animals were weighed daily before and after watering. The solid and liquid excreta were collected and analyzed during each period. These data, together with the amounts of food consumed, are fully tabulated and discussed, and from them calculations are made of the percentages of nutrients digested by each animal from the silage and the stover rations. Excluding the third period in each case, in which the grain ration was different, and averaging the results on the other silage and stover rations, there appears to be no very marked difference between the digestibility of the silage rations and the stover rations as fed, although the silage rations were slightly more digestible.

The amount of nitrogen stored in the body was estimated in the usual way. These figures show very wide variations in the case of the same coarse food both with the same and with different animals. Thus, while the two-year-old steer in lot 1 stored 323.34 grams of nitrogen from a ration of silage, corn meal, and cotton-seed meal, it stored but 38.93 grams from a ration of silage and corn meal, and the two-year old in lot 2 stored 193.33 grams from a ration of silage, gluten meal, and germ meal. In spite of this, however, it is evident from the data given that in every case except one a larger percentage of the nitrogen in the stover rations was stored in the body than of that in the silage rations; that is, the production of lean meat was slightly greater on the stover ration. The lower storage of nitrogen on the silage rations the author attributes to the acids in the silage, which he says "increased the consumption or waste of the albuminoids stored in the body." The percentage of acid in the silage, calculated as lactic and acetic acids, ranged from 1.29 to 2.27.

The digestion coefficients found for the nitrogen of the various rations are corrected for the metabolic products, which were determined in the feces by the method described by Jordan.* The results of these and of the determination of the coefficients for nitrogen by Stutzer's method of artificial digestion are tabulated.

A comparison was made of percentages of fat in the food and in the feces as determined by the ordinary method of extraction, and by filtering the ether extract through animal charcoal, as previously recommended by the author.† Differences between the two methods as large as 1.34 per cent of fat were noticed in the case of corn stover, but generally the difference was much smaller. The effect of these differences upon the percentages of digestibility was in some cases sufficiently large to warrant their being taken into account.

"Fifty-seven per cent of the nitrogen in the total excreta or manure was found in the urine."

*Agricultural Science, 2, p. 294.

†Maryland Station Report for 1890, p. 126 (E. S. R., vol. III, p. 516).

Feeding horses hay and grain mixed, J. W. SANBORN (*Utah Sta. Bul. No. 13, May, 1892, pp. 1-4*).—The effect of feeding the grain mixed with the hay and separately was tested in a trial with four horses, two receiving the grain and hay mixed and two separately. The grain consisted of nearly equal parts of rye, oats, and bran. The hay was cut. From January 12 to March 30 the grain was fed dry and from March 30 to May 25 it was moistened. The weights of the horses at five weighings and the amounts of food consumed are given. According to these weights the two horses fed hay and grain mixed weighed 133 pounds less, and the two fed hay and grain separately 103 pounds less at the close than at the beginning of the trial; but the author rightly remarks that "with work horses the variation in daily weights is very great and the difference noted is so small that it may be within the limits of error." Previous trials with sheep and pigs "failed to show any advantage in cutting and mixing hay with grain."

Feeding cut hay vs. whole hay to horses, J. W. SANBORN (*Utah Sta. Bul. No. 13, May, 1892, pp. 5-10*).—This was compared on two lots of horses. The feeding lasted from August 10 to December 21; November 3 the food for the lots was reversed. The hay was a mixture of alfalfa and clover and apparently was fed *ad libitum*. The food eaten and the weights are tabulated. In the first period the lot on cut hay gained 99 pounds and that on uncut hay 62 pounds; in the second period the lot on cut hay gained 75 pounds and that on uncut hay lost 5 pounds. The weighings were at the beginning and close of each period, intervals of from six weeks to two months, and, as the author remarked in the preceding article, the changes in weight noted are within the variations which might be expected for working horses.

Report on ostreaculture, J. NELSON (*New Jersey Stas. Report for 1891, pp. 179-231*).—A detailed report of observations and experiments in ostreaculture by the author in 1891, near Mathews, Virginia; near Cold Spring Harbor, Long Island; and at New Brunswick, Oceanic, Keyport, and Avon, New Jersey. The work was on broader lines than that recorded in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 302). Notes are given on each observation and experiment, as well as tabulated data for a considerable number of oysters used in experiments at the different localities. A record of sea temperatures at several places is also given. Under the head of "Oyster lore" the views of a number of experienced oystermen are presented regarding the conditions for a "set," oyster growth, oyster enemies, "giving oysters a drink," preservation of oysters, and the parasites of oysters. The following summary has been prepared from that given in the report:

Parasites.—(1) The parasite termed cytohelminth in our Report for 1890 was found to be present (with probably no exception) in oysters of (*a*) all ages, (*b*) both "naturals" and "plants," (*c*) from all sorts of beds, (*d*) in the waters of widely separated States, (*e*) at all seasons.

(2) This cytohelminth is identified by Dr. A. C. Stokes as *Trypanosoma balbiani*.

(3) The structure called "jelly worm" by the oystermen, "crystalline rod" by the zoölogists, and jelly rod in our tables, is analogous to a *zoöglœa*, in which the spores develop from which the cytohelminths arise.

(4) This jelly rod was found present in a situation similar to that in *Ostrea* in four other genera of Lamellibranchs, viz, *Mya arenaria* (long clam), *Venus mercenaria* (hard clam), *Pecten irradians* (scallop), and *Argina* (*Arca*) *pexata* (blood clam).

(5) In the oyster this rod dissolves within half an hour after the oyster is taken (summer temperature). Its presence, therefore, indicates the extreme freshness of the oyster.

(6) In cases in which the oyster is exposed to a hot sun on its own bed, left dry at low tide, this jelly rod was also found dissolved in the oyster *in natura*.

(7) This jelly rod consists of a collagenous substance, arranged in a series of segments of a complicated structure.

(8) The dissolution of the jelly rod is accompanied or preceded by the development of bacilli-like spores into cytohelminths in *Ostrea*, a phenomenon also noticed in several (but not all) of the specimens of the other genera of Lamellibranchs enumerated above (4).

(9) Never more than one jelly rod has been found in one specimen. The length varies from 1 to 2 inches, the diameter from one eighth to one sixteenth inch. The larger end is (sometimes) attached to the wall of the stomach by a rootlike organ (proboscis?).

(10) Other characterizations of this parasite given in our Annual Report for 1890 were substantiated.

(11) The cytohelminths are so sensitive to conditions of environment that no danger can be apprehended in taking them alive into the stomach; they would certainly die within a second or two.

(12) Freshening of oysters should be done with water that is tolerably pure, otherwise the microbic life in the water will invade the oyster. In the case of disease germs in sewage contamination, there is real risk of such being received by man if the oyster is eaten raw, unless a method of disinfection can be applied to the oyster after it is removed from its shell. In the case of cooked oysters no danger in this regard need be feared. In this connection we would emphasize points 10 to 16 and 22 to 27 of the Report of 1890, relative to the multiplication of putrefactive bacteria in marketed oysters. Long before oysters become too weak to keep their shells shut the bacteria have increased sufficiently to spoil the flavor of the oyster and probably are capable of causing dysentery. * * *

Feeding and growth of oysters.—(13) Oysters appear to feed (or "drink") on all tides. No rhythm was noticed in oysters in their native habitat, as was reported for oysters "given a drink" in salt water in the laboratory.

(14) The "food" of oysters, as investigated by examination of the contents of the stomach, consists of those organisms like Diatoms, Crustacea, Foraminifera, etc., that have resistant shells. Such examination can give no true idea of the relative importance of the different organisms eaten by oysters. It was found that Alga spores (*Floridiæ*) are the principal food where the oysters make the most rapid growth.

(15) Oyster growth is determined principally by four factors, viz: (*a*) *A warm temperature*, secured in southerly situations and shallow water. (*b*) *Animalcular and sporoid food*, secured by same conditions as (*a*) and favored by influx of fresh water in moderate quantities. (*c*) *Current*, in part favored by conditions of shallowness; the result of *current* is to bring increased quantities of food to the oyster and to relieve it from much work in preventing sediment from burying it. (*d*) *Shallowness of water*, a condition favoring (*a*), (*b*), and (*c*), and in addition securing to the oyster the richer food supply of the ocean surface and increased facilities for oxygenation. Surveys of the conditions of the oyster industry establish the law that the rate of growth is proportional to the favoring presence of these four factors.

(16) [A submarine mower successfully used on oyster beds at Oceanic, New Jersey, may be briefly described as follows:] It cuts a 12-foot swath of eelgrass from the oyster beds in water varying in depth, at the rate of five minutes per 1,000 linear feet. A scow carries a boiler, engine, and water reservoir. At one end of this scow a framework suspends a double set of mowing knives, one set pointing forward and one set backward. These are set in motion by a vertical iron shaft passing through a horizontal, cogged wheel which is geared to a pulley run by the belt from the engine. The vertical shaft can slip up and down through the toothed wheel to accommodate the mowing knives to different depths. This is done by windlass, pulleys, and chains suspending the knife frames. On the main pulley shaft is a smaller grooved wooden pulley. Around the latter is passed a few turns of the guide and propelling rope. This is 1,000 feet long and the ends of this rope are anchored at opposite sides of the bed. Thus, when the engine is running, the same shaft that communicates motion to the knife-mover drags the scow along the rope. When one end is reached the rope is passed around the pulley in the opposite direction, and the scow then propels itself backward. As both sets of knives are always in motion the machine cuts a swath when running backward as well as when it runs forward. Thus no time is lost in turning around. The scow is guided by "poling." Several swaths can be cut without moving the anchors, because the long rope, however well stretched, allows of considerable side swaying.

This machine will not work in salad or cabbage (*Ulva*), but is admirable in eelgrass. In fact it works best where the conditions for oyster growth are best. The presence of a current, so favorable to oyster growth, helps to float away the cut grass. If the eelgrass is allowed to grow it retards the current and so retards oyster growth.

(17) The earlier an oyster can ripen its spawn and the shorter the spawning period the quicker will it be fit for market, but marketable oysters can also be secured by delay of this maturity or by the entire prevention of spawning.

Southern oysters are in good condition until near August if planted in Northern waters. Northern oysters in Southern waters recover from spawning so as to be in good condition by the last of July. In this way the oyster season can be kept continuous, but due care must be taken to keep the oyster *very cool* in market, etc.

(18) A high and prolonged temperature keeps oysters a long time in spawn, but the amount of spawn present is relatively small and the nutritive value of such oysters is inferior to that of oysters from colder waters.

The spawning of oysters.—(19) Southern oysters in Southern waters have a longer spawning period than Northern oysters in Northern waters.

(20) Obscure conditions affect the spawn of oysters, producing deterioration, so that abortive development results to a degree beside which the influences of all other enemies or forces destructive of oyster spawn are insignificant. Conditions of this sort are not equally present every season, and even vary during the course of a single week.

(21) Low temperatures have a remarkable effect in lengthening the period of activity of spermatozoa.

(22) Mature and normal spawners show a difference in coloration for the two sexes (the male being a darker tint), which enables the naked eye to detect the sexes, but only microscopic examination can give a correct idea of the character of the eggs or spermatozoa.

The development and fixation of spawn.—(23) The conditions causing abortive development acted very strongly during 1891, preponderating in the South.

(24) The summer of 1891 was very favorable for natural "sets," and for "sets" on planted shells (principally due to the dryness of season). Most of the experiments made to secure fixation of spat to collectors, under artificial conditions, failed of this result.

(25) Spawn from Delaware seed planted at Oceanic and fertilized there was transported by rail to Keyport, planted in a claire, and raised as seed oysters upon shells.

(26) [Observations are reported which led the author to suggest that claires might be constructed on the following plan:] At right angles to the general shore line of the inlet a series of ditches about 4 or 5 feet wide should be dug as close together as practicable and running back throughout the entire width of the marsh. The ends of these ditches should open into a wider ditch or reservoir, dug so as to connect all the series by extending at right angles to the narrower ditches. The end of each ditch opening to the waters of the inlet should be closed by two gates, one intended to keep out the water at pleasure of the operator, and one furnished with a "strainer," constructed of two finely meshed wire nets (or of slatwork, coated with tar or other protective substance), holding between them a layer consisting of fine sand in the center and of gravel coarse enough to be held by the meshes outside. The strainers should be constructed with the largest possible surface, and should allow as free a passage of water as may be consistent with the retention of the spawn. Water should flow through this strainer only after half flood. At low water there should be retained a foot of water in the ditches. * * *

(27) Water in an aquarium for oyster culture can be kept sweet best by means of an aërator ("aspirator").

(28) The growth of the shell-planting industry has been very rapid in Virginia during the last two years.

(29) Oyster culture requires that a corps of observers of "marine climate" should be equipped by governmental action, just as are the weather observers.

VETERINARY SCIENCE AND PRACTICE.

Antiseptic treatment of wounds, E. P. NILES (*Virginia Sta. Bul. No. 13, Feb., 1892, pp. 11-11*).—General statements regarding the organisms which cause suppuration, and brief accounts of experiments with boracic acid, salicylic acid, iodoform, europhen, hydronaphthol, and salol on cultures of *Staphylococcus pyogenes aureus.*

Potato broth with agar-agar was used as a culture medium. Surface inoculations were made and the powder dusted over the surface. At the same time control tubes were made to test the vitality of the culture. In the case of iodoform, hydronaphthol, and salicylic acid, no growth took place, while with boracic acid a slight growth was noticed, and with europhen and salol the growth was not hindered in the least. * * *

Experiments were also made with a solution of hydronaphthol on the *Staphylococcus pyogenes aureus* in a fluid culture medium (beef broth). A sufficient quantity of the solution was poured into the tube, so that the germs were in a solution of the drug in the proportion of 1:1280. Inoculations were made at intervals of five minutes, beginning at five minutes after the solution had been added to the culture and ending at thirty-five minutes, making in all seven inoculations. No growth at all took place in any of the tubes except the one at twenty-five minutes, which we attribute to an accident at the time of inoculation.

As the hydronaphthol was first put in solution with alcohol (which in proper strength acts as an antiseptic) and water enough added to make the desired strength, inoculations were made from tubes treated with a simple mixture of alcohol and water in the same proportion as the other solution. In these an abundant growth took place, thus proving that the antiseptic properties in the first instance were entirely due to the hydronaphthol.

Infectious abortion in cows, E. P. NILES (*Virginia Sta. Bul. No. 13, Feb., 1892, pp. 15, 16*).—Brief statements regarding the cause, symptoms, and preventive treatment of this disease.

Report of veterinarian of Louisiana Station for 1891, W. H. DALRYMPLE (*Louisiana Stas. Bul. No. 15, 2d ser., pp. 407–424*).—Popular statements regarding the causes, symptoms, and treatment of the following diseases: Fistulous withers, colic, foot evil, horse botflies, ox warble, lockjaw, charbon, hydrophobia, and glanders. A tabulated statement is given regarding the outbreaks of glanders in different localities in the State.

DAIRYING.

E. W. ALLEN, *Editor.*

Analyses of milk and other dairy products (*Massachusetts State Sta. Report for 1891, pp. 21, 43, 69, 83, 170, 299, 337*).—Analyses of milk in 1891 and a compilation of analyses of whole milk, skim milk, buttermilk, butter, cheese, etc.

Bacteria in the dairy, H. W. CONN (*Connecticut Storrs Sta. Report for 1891, p. 172*).—Mention is made of two series of experiments which are in progress, one on the artificial ripening of cream by means of pure cultures of bacteria, and the other to ascertain "whether the dairies of this country are under the influence of the same set of species of bacteria as the dairies of Europe."

Several distinct species of organisms have been found very abundant in souring milk, which certainly sour it in a normal manner, but we have been forced to conclude, as a result of experiments thus far, that the lactic organism described by Hueppe [*Bacillus acidi lactici*] is at all events not common in the vicinity of Middletown.

AGRICULTURAL ENGINEERING.

Preservation of fence posts, A. I. HAYWARD (*Maryland Sta. Report for 1891, pp. 377, 378*).—In November, 1889, 30 posts cut from the same oak tree were set in holes 3 feet deep. The posts were divided into six sets of five each. Before being planted the different sets were prepared as follows: "(1) Entire surface covered well with crude petroleum applied with a brush; (2) similarly covered with the same oil from the lower ends to a line about 6 inches above the surface of the ground as planted; (3) painted entirely with creosote oil instead of petroleum; (4) painted with creosote oil, but only as high as those in set No. 2; (5) entirely covered with 'cable coating,' a material of about the consistency of common axle grease; (6) covered with cable coating, extending to a line 6 inches above the ground."

STATION STATISTICS.

Reports of executive committee, treasurer, and director of Connecticut Storrs Station for 1891 (*Connecticut Storrs Sta. Report for 1891, pp. 5–8*).—Brief general statements regarding the work and officers of the station, and a financial report for the fiscal year ending June 30, 1891.

Summary of Annual Report of Connecticut Storrs Station for 1891 (*Connecticut Storrs Sta. Bul. No. 8, Apr., 1892, pp. 16*).—This includes summaries of the following articles, which were printed in the Annual Report of the station for 1891: Food investigations, forage crops, nitrogen of the air as plant food, fertilizer experiments on grass, and field experiments with fertilizers by farmers.

Reports of director and treasurer of Maryland Station for 1891 (*Maryland Sta. Report for 1891, pp. 235–218*).—General statements regarding the work of the station in various lines and a financial report for the fiscal year ending June 30, 1891.

Report of treasurer of Massachusetts State Station, F. E. PAIGE (*Massachusetts State Sta. Report for 1891, p. 314*).—This is for the year ending December 31, 1891, and contains a statement of the receipts and expenditures of the station and an inventory of the station property.

Report of director of New Jersey Stations (*New Jersey Stas. Report for 1891, pp. 4*).—A brief review of the work of the several departments for the year and a list of the bulletins published by the State and College Stations.

Report of treasurer of New Jersey State Station, J. NEILSON (*New Jersey Stas. Report for 1891*).—A financial statement for the year ending December 31, 1891.

Legislation, station work, and publications (*New Jersey Stas. Report for 1891, pp. 427–417*).—This contains the acts of the State legislature relating to the station, fungous diseases of plants, the State weather service, and the inspection of fertilizers; directions for sampling fertilizers and feeding stuffs; the order of station work during the year; and a catalogue of the bulletins issued by the station from its organization in 1880 to December 31, 1891.

Fourth Annual Report of the New Jersey College Station for the year ending June 30, 1891 (*New Jersey Stas. Report for 1891, pp. 449–453*).—This contains a brief statement regarding the organization of the station and a financial report for the fiscal year ending June 30, 1891.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Report on the acreage of wheat and cotton, condition of cereal crops, and freight rates of transportation companies (*Division of Statistics, Report No. 96, n. ser., June, 1892, pp. 199–244*).—This includes articles on the acreage of wheat and cotton, condition of cereal crops, European crop report for June, notes on foreign agriculture, and transportation rates.

Foods and food adulterants—tea, coffee, and cocoa preparations, G. L. SPENCER AND E. E. EWELL (*Division of Chemistry, Bul. No. 13, part* VII, *pp. 875–1014, plates 9*).—This includes statistics of consumption; methods of preparation and adulteration; methods of analysis; analyses by the chemists of the Division of samples purchased in the open market; analyses from other sources; discussion of results of the investigation; a bibliography of the literature of tea, coffee, and cocoa preparations; the text of the United States tea adulteration law; and abstracts from the Italian law relating to the adulteration of foods. The plates accompanying the text contain illustrations of genuine tea leaves and possible adulterants; the upper and lower epidermis and the stone cell of the tea leaf; seed coat of coffee; cross-section of raw coffee; the outer, second, and gluten layers of wheat bran; parenchyma cells, milk vessels and pitted cells of chicory; and cocoa husks.

Some of the general results of the investigation are stated in the following paragraphs taken from the report:

> *Tea.*—A large number of the samples examined were faced. Facing consists in treating the prepared leaves with mixtures containing Prussian blue, turmeric, indigo, or plumbago, to impart some favorite color or gloss to the leaf, and always has a fraudulent intent. Leaves which have been damaged in the manufacture or which from their age or certain imperfection are inferior, are faced to improve their appearance and price. The teas consumed by the Chinese and Japanese themselves are not faced, while those for export seldom escape this treatment. The Chinese and Japanese black teas are usually treated with plumbago (black lead). * * *
>
> With the present ideas in regard to this practice, it can not be considered a form of adulteration, but facing should be condemned on account of its use in making inferior teas appear to be of a superior quality. This practice also enables the admixture of spent leaves with little fear of detection. Faced teas can not be excluded from this country under the United States tea adulteration act, since this law specifies that the addition of chemical and other deleterious substances must be in sufficient quantities to render the tea unfit for use. This wording admits of excessive facing, since it has never been shown that the substances usually employed for this

purpose are prejudicial to health, even when taken in greater quantities than could be employed in treating teas. * * *

The analytical and other work in connection with this report indicates that there are few if any spurious teas on the market. The range in quality is undoubtedly very great, many samples deserving to be termed "tea" simply because they are composed of the leaves of the *Thea*, and not through the many pleasant qualities which we usually associate with the beverage of this name.

With the strict enforcement of the United States adulteration act, the consumer is reasonably well protected, so far as securing the genuine leaf is concerned, but of course has no protection from the sale of inferior teas.

Coffee.—The examination of the coffees and coffee preparations on our markets shows that the consumers, and especially the poor, are being grossly deceived. Very little pure ground coffee is sold, and even whole coffee does not escape sophistication. The purchase of green coffee for home roasting does not insure a pure product, since even the green coffee is imitated. Stringent laws are certainly needed to suppress these frauds.

That there is a large demand for imitation coffee is evidenced by the fact of its importation from Germany. The manufacture of these coffees in imitation of the form of the genuine bean should be interdicted, even if the product is to be sold as a substitute.

Cocoa preparations.—[Of 61 samples analyzed in the laboratory of this Department, 27 contained large additions of starch or flour, 14 large amounts of cocoa husks, and 33 from 50 to 72 per cent of sugar. The nutrients in a cup of pure cocoa containing 2.5 grams of the material, are calculated to be protein 0.5, fat 0.6, and carbohydrates 0.6 gram.]

Beef tea was once considered to be a very concentrated and easily digestible food, and was given to invalids in small quantities with full confidence in its great, almost miraculous, nourishing power. It has long since been degraded very nearly to the rank of a mere stimulant, and is never intelligently administered, except when accompanied by an ample amount of nourishing food. As a concentrated and easily digestible food for invalids cocoa preparations are already beginning to share the same fate; as material for the preparation of pleasant, exhilarating, and slightly nutritive beverages for both weak and strong, the career of cocoa preparations is only just begun. Moreover, their progress in popular favor will keep pace with the manufacturers' appreciation of this fact. * * *

The results of these investigations emphasize in many ways the many pleas that have been made for the establishment of standards of purity, strength, and quality for foods—for some certain means of enabling the public to know the strength, quality, and degree of purity of the food materials on the markets. The question of economy alone is sufficiently important to justify serious consideration of this need, for no question can be of more importance to a great part of our nation than questions of economy in food, drink, and clothing.

Experiments with sugar beets in 1891, H. W. WILEY (*Division of Chemistry, Bul. No. 33, pp. 158*).—This is a record of the experiments in the culture of the sugar beet and the manufacture of sugar therefrom, conducted by the author in 1891, with the collaboration of W. Maxwell, W. A. Henry, and others. The Department of Agriculture distributed to farmers 15,000 packages of sugar beet seed, each package accompanied by directions for the planting and cultivation of sugar beets, and for taking samples of the beets for analysis and forwarding them to the Department. About one third of those receiving seed forwarded samples of beets. The results of the analyses of these are tabulated by States and Territories and by counties. The averages by States and Territories are as follows:

Average results by States and Territories of the sugar beet trials.

State.	Number of growers.	Analyses of beets.				Yield of beets per acre.	Probable yield of sucrose per acre.
		Total solids.	Sucrose in juice.	Sucrose in beet.	Purity.		
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Tons.*	*Pounds.*
Arizona	2	14.56	8.09	7.69	56.9	....	....
Arkansas	2	11.42	6.73	6.39	58.8	....	....
California	4	15.24	11.64	11.06	75.8	14.2	2,188
Colorado	30	17.75	13,76	13.08	76.1	14.8	3,223
Connecticut	3	14.56	11.34	10.77	77.3	14.2	2,305
Georgia	2	17.78	11.60	11.03	64.9	....	....
Idaho	1	17.87	13.40	12.76	74.9	....	....
Illinois	22	16.09	12.34	11 73	76.4	15.7	2,798
Indiana	56	15.97	12.32	11.64	76.9	14.0	2,416
Indian Territory	1	15.99	13.05	12.40	81.6	20 9	3,816
Iowa	214	16.32	12.46	11.82	75.7	17.3	2,914
Kansas	20	16.45	11.25	10.69	68.2	16.2	2,387
Kentucky	2	14.69	9.60	9.12	63.7	....	....
Maryland	1	11.26	7.75	7.36	68.5	....	....
Michigan	36	16.91	13.31	12.64	78.0	17.2	3,444
Minnesota	27	17.12	13.03	12.38	75.7	18.5	3,251
Missouri	29	17.48	11.01	10.42	62.4	22.1	2,379
Montana	32	17.99	13.93	13.23	76.8	17.6	3,495
Nebraska	45	16.22	12.37	11.67	75.3	13.2	2,351
Nevada	3	20 47	18.10	17.20	88.0	7.8	2,340
New Hampshire	1	15.28	12.25	11.64	80.0	14.8	2,486
New Jersey	1	10.91	7.72	7.33	70.8	13.1	1,236
New Mexico	10	19.21	14.53	13.81	74.8	15.5	2,793
New York	3	15.83	12.21	11.58	76.8	....	....
North Dakota	10	16.97	12.46	11.84	73.2	16.0	2,568
Ohio	48	16.23	11.93	11.33	73.5	16.9	3,055
Oklahoma	1	12.58	6.91	6.37	53.3	....	....
Oregon	31	17.72	14.57	13.84	82.2	15.6	3,480
Pennsylvania	5	17.78	13.98	13.29	78.7	15.6	2,772
South Dakota	138	17.41	13.11	12.45	75.3	16.7	2,958
Tennessee	3	14.02	9.23	8.77	65.8	6.5	1,306
Texas	7	15.57	10.85	10.31	69.1	12.9	1,663
Virginia	17	15.32	11.80	11.12	76.0	19.3	2,768
Washington	6	18.34	15.23	14.47	83.9	8.2	1,511
Wisconsin	402	15.35	11.64	11.05	75.8	16.1	2,833
Wyoming	10	18.18	14.19	13.48	78.1	11.1	2,130

In regard to the data by States, it must be remembered that they can not be taken to represent actually the possibilities of each State in the growth of sugar beets. In the first place the results of a single year of culture, however carefully it may be conducted, could not be conclusive in regard to the possibilities of any one State or locality in the production of beets. In the second place it must be understood that the farmers of different States may not have followed exactly the same method of sampling beets. In some of the cases at least, where the general average of the State seems to run low, it is found that the average weight of the beet was far above that which is required of a beet of high saccharine strength.

The results, therefore, must be regarded as simply tentative, showing in general where beets of fine quality can be produced, but not in any way deciding on the comparative ability of the several States for the production of rich beets.

Reports are given of sugar beet experiments in Wisconsin by W. A. Henry, and of the work of the Beet Sugar Experiment Station of the U. S. Department of Agriculture, at Schuyler, Nebraska, by W. Maxwell, who was in charge of the station during the season; together with a letter from H. T. Oxnard on the prospects of the beet sugar industry in the United States.

Prof. Henry's report shows that 1,000 pounds of sugar beet seed was distributed to 850 farmers in Wisconsin. Samples of the beets grown were sent by 373 persons. A large number of others reported failure of the crop on account of severe drouth. According to the analyses of

these samples, the percentage of sugar ranged from 7.12 to 23.52 and averaged 12.56. The average yield is estimated at over 15 tons of roots per acre. The beets grown at the station ranged from 13.27 to 17.56 per cent in sugar, averaging 15.5 per cent. At the station the estimated cost of growing and harvesting beets with a yield of 14 tons of roots per acre, at the current wages, is $3.76 per ton of washed beets.

At Schuyler field experiments were made on the yield of cleaned beets of different varieties, early *vs.* late planting, distance of planting, time of harvesting, the effect of fertilizers, and the changes in weight and in sucrose content of beets after pulling. Some of the more important indications of these experiments are here given.

Yield of different varieties.

(Mean of field A and field B.)

Varieties.	Weight of beets per acre.	Sugar per acre.	Purity of juices.
	Tons.	*Pounds.*	*Per cent.*
Elite	19.33	5,564	81.6
Knauer	19.49	5,613	86.4
Lemaire	20.94	5,698	86.0
Desprez	23.85	6,459	86.2
Vilmorin	23.45	6,407	85.4
Klein Wanzleben	23.55	6,521	83.3

The analysis of the varieties does not require further comment. The almost identical values of the Klein Wanzleben, Desprez, and Vilmorin varieties are very notable. The other varieties form a second class in respect of the actual money value per acre. * * *

The experiments conducted with the view of observing the results of early and late planting indicated that early planting may be expected to give the highest money value yield per acre. * * *

The fertilizer experiments indicate that the soil of the station farm contains all the constituents of plant food in abundance, and that artificial aid can not be given to the growing plant with any apparent advantage.

In respect to the distances that the beets should be placed from each other or the number of plants given to an acre, the experiments on the No. 1 series of the small plats have shown conclusively that the money value of the crop was greatest where the greatest number of beets were placed upon the acre. * * *

The means of analyses indicating the condition of the beets at the periods when the tests were made, show that the crop generally, and particularly in field B, where the beets were planted early, had reached a high condition, in respect of the weight of the beets and the sugar content of the juices, on September 15. Further, that certain of the varieties had reached a maximum value by September 25 and that all of the varieties were at their best by October 15, and after that date the content of sucrose began to fall away. Those observations indicate the time when in a normal season the harvesting and handling of the beets by the factories should commence in that part of Nebraska. The past season has been an abnormal and late one, and it is apparent that with a moderately early planting season (April 20 to May 1), and proper cultivation, a crop should be ready for the factory commencing September 1. * * *

Commencing September 1, a three months' factory season is almost assured, and that would enable a factory with a capacity of 300 tons per day to work up about 30,000 tons of beets by December 1, or the product of 3,000 acres at 10 tons per acre.

The experiments made in order to determine the loss of weight by evaporation and to ascertain the effect of evaporation with the removal of the beets from the earth upon the sucrose contained in the beet, have indicated that no gain occurs in the sucrose content of the beet, but that an actual loss of sugar takes place if any length of time is allowed to transpire between the raising of the beets from the soil and the handling of them in the factory. It thus appears of advantage to the grower and the manufacturer that the beets should not only be harvested at the period of their maximum sugar value, but that they should be handled by the factory as nearly as possible as they come fresh from the field.

A large number of beets were selected for beet mothers, and the changes of these in the silo are to be studied in the spring.

The work of the Department has certainly resulted in great good in interesting people in all parts of the country in the problem of sugar beet culture. The Secretary of Agriculture has, however, decided not to make as large a distribution of sugar beet seed in the manner practiced during the past two years, but to concentrate his efforts in the development of a sugar beet station, in which practical illustrations can be given of the very best methods of sugar beet culture and the selection of mothers for the production of a high grade of seed.

Record of experiments with sorghum in 1891, H. W. WILEY (*Division of Chemistry, Bul. No. 34, pp. 132*).—The experiments reported upon include those in the manufacture of sugar from sorghum juices, especially by means of the alcohol method of separation (E. S. R., vol. II, p. 469); in the treatment of molasses from other sugar houses; and culture experiments at Sterling, Manhattan, and Medicine Lodge, Kansas, and at Patterson, Louisiana.

The proposed use of alcohol in the manufacture of sugar from sorghum is not claimed as new by the Department. Many years ago a French chemist, H. Joulie, published a work on sorghum sugar, entitled *Etudes et Experiences sur le Sorgho a Sucre*. On pages 106 *et seq.* he speaks of a proposed method for the manufacture of sugar from sorghum by the use of alcohol, in which the alcohol was applied directly to the expressed juice of the cane.

There is no doubt of the fact that this method would work admirably, and the only objection to it is in respect of the great amount of alcohol which would be required. For this reason it will never be adopted in practice unless alcohol should become very much cheaper than it ever has been in the markets of the world.

The process of Joulie, moreover, could only be employed with mill juices, and not to advantage with diffusion juices, which are much more dilute than mill juices and would require a much larger quantity of alcohol. * * *

Several years before Joulie proposed to use alcohol for making sugar from sorghum, an English patent, No. 655, issued March 27, 1858, was granted to William Armond Gilbee for the use of alcohol in the manufacture of sugar. * * *

The method proposed by Joulie, which was never practiced except in the laboratory, is essentially the same as that which was adopted by the Department of Agriculture, with the exception of the stage of the process at which the alcohol is applied.

[In the method as used by the Department the alcohol is added to the clarified diffusion juice after the latter has been concentrated to a sirup containing about 55 per cent of solids.]

The principle of the method practiced by the Department rests on a different basis from that described by Gilbee. The chief object of the method of Gilbee is to get rid of the alkaline salts of beet sirup, while the object of the experiments carried on by us was to separate the incrystallizable carbohydrates. While the method of Gilbee embodies the main process of our method, it is seen without discussion that it could not be applied economically.

It is but just to say that our method was developed, perfected, and carried out in its experimental work before our attention was called to the patent of Gilbee in March, 1892, by Prof. C. A. O. Rosell of the Patent Office.

The use of alcohol for percipitating gums for chemical purposes has long been practiced. Its application to sorghum molasses for this purpose is described by Dr. Peter Collier and Mr. Clifford Richardson in the Annual Report of the Department of Agriculture for 1878, page 107. * * *

It appears from the experiments which were conducted that one of the chief advantages of this process is not so much in the increased yield of sugar as in the ease with which the material can be passed through the sugar factory. With ordinary sorghum massecuite it is necessary to run a centrifugal machine from fifteen to thirty minutes in order to dry a very small charge, while with massecuite made by the alcohol process from two to five minutes have been found to be entirely sufficient for the maximum charge.

Insect Life, (*Division of Entomology, Insect Life, vol.* IV., *Nos. 9 and 10, June, 1892, pp. 293–352, figs. 17*).—This double number contains the following articles:

The pea and bean weevils (pp. 297–302).—A summary of the main facts in the life histories of the pea weevil (*Bruchus pisi*) and the bean weevil (*B. fabæ*), compiled from C. V. Riley's third report as entomologist of the State of Missouri, with the addition of subsequent notes principally concerning the earlier stages of these insects. The accompanying illustrations represent the two species in their different stages.

The ox bot in the United States, C. V. Riley (pp. 302–317).—This contains a somewhat detailed account of the life history of the ox botfly, ox warble, or heel fly, as it is variously called. The ox bot of this country, hitherto supposed to be synonymous with the European species *Hypoderma bovis*, is referable to a distinct species, *Hypoderma lineata*. This insect is distributed throughout the European countries and practically throughout the United States, but whether of American or European origin remains to be determined. *H. bovis* also abounds throughout Europe, but has never been found to occur in America, which is a remarkable fact when it is considered how frequently cattle are imported from abroad. The main facts in the life history of *H. lineata* as observed in this country may be briefly summarized as follows:

The eggs are fastened to the hair on various parts of the body, particularly on the flanks and on the legs near the heels, and are taken into the stomach by the cattle when they lick themselves. The egg splits and the young larva or grub, which was well developed when the egg was laid, is released and attaches itself by means of the spiny processes with which its body is armed to the esophageal wall. It soon molts and remains in the second or smooth stage for eight or nine months, wandering slowly about in the tissues of its host, partaking of little nourishment, and developing very slowly, if at all. During the winter the larva of this stage penetrates the skin, and molting a second time reassumes its spiny character and develops rapidly. A third molt then takes place, the larva of this stage living within the swell-

ings or sacs under the animal's skin. In the course of time it works its way out, enters the ground, and assumes the perfect stage or puparium, which is simply the contracted and hardened larva, the mature insect or fly issuing a few weeks afterward.

The insect is described and illustrated by numerous figures representing its various stages; the differences between it and *H. bovis* are presented in tabular form, with accompanying diagrams and figures of both species for comparison.

The ravages of the leopard moth in Brooklyn, N. Pike (pp. 317–319).—An account of the depredations of the leopard moth (*Zeuzera pyrina*) in Brooklyn, New York. This destructive insect, which is of European origin, has been known in this country for the past five years, but has not until very recently extended its ravages beyond a radius of a few miles from New York City. According to the writer, however, it is rapidly spreading to the surrounding country and may eventually prove a much more serious pest and one more difficult to eradicate than the pernicious Gypsy moth. Like that insect, it is a general feeder, affecting a great variety of woody plants, particularly elm and maple. The larvæ attack only living trees, boring into the larger branches and the heart of the tree. Illustrations of the insect are given, and a list is appended of twenty-four trees and shrubs observed by the writer to be affected by it.

How far do bees fly? F. Benton (pp. 319–321).—A discussion showing the error of recent popular computations of the distance bees go after honey. Observation and experiment, it is stated, show that the usual range of flight is 2 to 3 miles, and that pasturage to be profitable should be within this distance of the apiary.

Note on the water bug found by J. L. Zabriskie, E. Bergroth (p. 321).—A short note on the water bug previously described and figured in Insect Life, vol. IV, p. 198 (E. S. R., vol. III, p. 548). The species is identified as an undetermined adult male of the family Hydrometridæ and the name *Rheumatobates rileyi* is proposed for it.

The locust or grasshopper outlook (pp. 321–323).—A summary of a paper presented by Prof. Riley in 1891, before the American Association for the Advancement of Science to offset published statements calculated to cause unnecessary alarm.

Early published references to some of our injurious insects, II, *F. M. Webster* (pp. 323-326).—A continuation of a paper begun in Insect Life, vol. IV, p. 262 (E. S. R., vol. III, p. 812), concerning early accounts of our more common injurious species of insects. The following species are referred to in this article: *Isosoma hordei*, *Elachista præmaturella*, *Cecidomyia destructor*, *Gortyna nitela*, and *Heliothis armigera*.

Strange developments of stomata on Carya alba caused by Phylloxera, D. A. Owen (p. 327).—A paper read before the Indiana Academy of Sciences, December 30, 1891.

Extracts from correspondence (pp. 327–335).—Among the letters published under this heading the following are of special interest: Destruction of plant lice in the egg state; remedies for leaf-cutting ants; a new fumigator for scale insects—a detailed description of a new kind of apparatus used in California; the fumigation of scale-infested fruit trees; life history and treatment of the mosquito; loss from grain weevils in Texas, and the bisulphide of carbon remedy; addition of lime to arsenical spray; bumblebees and the production of clover seed.

General notes (pp. 335–352).—Accounts are given of the appearances of different species of insects on the surface of snow and of the receipt in Africa of recent consignments of the Vedalia. Abstracts are given of resolutions for the protection of fruit trees in California. Other notes treat of the following topics: Strawberry leaf roller in Kentucky; Phylloxera at the Cape of Good Hope; a new tree band; a true bug damaging peanuts in China; Sarcophaga in the human ear; Japanese peach moth; hop louse and the use of quassia *vs.* kerosene as a remedy for it; Angoumois grain moth in Pennsylvania; and abundance of *Attagenus piceus* in Illinois.

Manual of the Phanerogams and Pteridophytes of western Texas, J. M. COULTER (*Division of Botany, Contributions from the U. S. National Herbarium, vol.* II, *No. 2, June 1, 1892, pp. 153–345, plates 2*).—This is the second part of a manual intended to include descriptions of all Texan plants west of the ninety-seventh meridian. The first part, containing the Polypetalæ, was issued as vol. II, No. 1, of the same series (E. S. R., vol. III, p. 103). The Gamopetalæ described include 925 species in 275 genera belonging to 31 orders. The largest orders are the Compositæ, represented by 430 species in 127 genera; Scrophularineæ, 66 species in 21 genera; Labiatæ, 60 species in 24 genera; Asclepiadeæ, 38 species in 9 genera; Boragineæ, 34 species in 10 genera; Convolvulaceæ, 33 species in 8 genera; Solanaceæ, 31 species in 13 genera; Rubiaceæ, 30 species in 10 genera.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

On the determination of potash, F. JEAN and TRILLAT (*Bul. Soc. Chim.* 7 (*1892*), *ser.* 3, *pp.* 228).—The aqueous solution containing potash is heated with a slight excess of sodium hydrate to expel the ammonia, filtered if necessary, acidulated with hydrochloric acid, and evaporated to a sirup with an excess of platinic chloride. After being taken up and washed with alcohol and ether the platinum salt is dissolved in boiling water and treated while hot with an alkaline solution of sodium formate, which reduces the platinum. This is collected on a filter, washed with acidulated water, incinerated, and weighed. Objections to the method are that the sodium formate decomposes, the reduction of the platinum takes place slowly, and the latter adheres to the sides of the vessel. These objections are overcome when the reduction of the platinum salt is effected by means of formic aldehyde solution, a few drops of which are added to the alkaline solution. The reduction is almost instantaneous and the platinum separates out, when the liquid is stirred during the heating, in black clots, which are easily collected. Formic aldehyde solution can easily be preserved without decomposing.—E. W. A.

Volumetric method for determining phosphoric acid, M. SPICA (*Gazetta chimica italiana*, *22* (*1892*), *p.* *117*; *abs. in Chem. Ztg.*, *1892*, *Repert.*, *p.* *148*).—The method is said to be especially applicable to the determination of phosphoric acid in Thomas slag and other phosphates used for fertilizing purposes. The iron, manganese, silicic acid, and aluminium are first removed either by means of sodium carbonate, or better, sulphuric acid. According to the first method the fertilizer is smelted in a porcelain crucible with sodium carbonate and silica, ground, and extracted with hot water; the filtrate is evaporated to dryness, taken up in water, acidulated with hydrochloric acid, evaporated to dryness, and again taken up in water.

According to the second method, the phosphate is evaporated nearly to dryness with concentrated sulphuric acid, the residue extracted with absolute alcohol, and the solution evaporated and neutralized with soda.

The phosphoric acid is determined volumetrically in either solution. A few drops of phenolphthalein are added to the solution which is then carefully neutralized and made to a definite volume. To an aliquot part a titrated solution of ferric-potassium sulphate (iron alum) is added until the phosphoric acid is all precipitated as ferric-phosphate, the

end of the precipitation being recognized by means of salicylic acid. After complete precipitation of the phosphoric acid the slightest excess of iron solution gives a violet color with salicylic. The strength of the iron solution is determined by titrating with ammonium sodium phosphate.—E. W. A.

A new and rapid method for the determination of nitrogen in organic bodies, W. F. K. STOCK (*Analyst, 1892, pp. 109-113*).—This method is similar in principle to the Kjeldahl method, using manganese dioxide as the oxidizing agent. From 0.5 to 1 gram of substance is heated without boiling in an Erlenmeyer flask or small beaker with 10 c. c. concentrated sulphuric acid and 5 grams of pulverized native manganese dioxide, until the solution assumes a dark-green color, owing to the formation of manganic sulphate, which indicates the end of the reaction. The digestion flask or beaker is cooled, cold water is added, and the contents are transferred to a copper distilling flask; an excess of sodium hydrate is added, and the ammonia distilled, collected, and titrated. The distilling flask is supplied with a supply tube for adding sodium hydrate and a wide evolution tube to act as a reflux tube in case of sudden frothing. A Wurtz flask is interposed between the distilling flask and the condenser, which serves as a wash flask and holds back the sodium hydrate. Both flasks are kept boiling throughout the test. The copper-distilling flask is used because the breakage was very large with glass flasks, owing to the bumping.

The method now disclosed can not be looked upon as simply a modification of Kjeldahl's process. Kjeldahl effects oxidation at the expense of sulphuric acid, and although he uses potassium permanganate to complete the oxidation he does not rely upon it as a principal reagent.

Kjeldahl's method requires much more time than the method I propose. I have completely oxidized a sample of bone powder in three minutes, and have determined the nitrogen in fifty minutes from the time of weighing out the sample.

The following percentages of nitrogen were found:

	By combustion.	By new method.
Bone meal	3.54	3.64
Cotton cake	3.69	3.49
Cotton-seed cake	3.68	3.61; 3.49
Fish flesh	7.41	7.51
Commercial uric acid	33.09*	32.70, 32.51

* Theoretically.

"Attempts have been made to use the method for determining the nitrogen of ferrocyanides and some alkaloids, but so far without success."

Fears were expressed by Mr. Dyer and Mr. Coste that the addition of manganese dioxide would result in a loss of nitrogen. They had found that the addition of permanganate in the Kjeldahl process was not only unnecessary, but in some cases might cause serious error.—W. H. B.

On the occurrence in various plants of a xylose-yielding gum,

A. HÉBERT (*Ann. Agron.*, *18 (1892), No. 5, pp. 261–267*).—The synthesis of the carbohydrates of plants is briefly discussed. The demonstration by Maquenne of the heptose character of the perseite of Müntz and Marcano, and the discovery of the pentose character of arabinose by Kiliani and of xylose by Wheeler and Tollens, have strengthened the theory of the formation of the carbohydrates from formic aldehyde. There have now been found in plants substances having carbon atoms as follows: Glycerin of the fatty acids C_3, erythrite C_4, pentaglucoses C_5, glucoses C_6, and heptaglucoses C_7. The author has investigated the distribution of xylose-yielding gum in different families of plants. He has found it in hay of grasses, in alfalfa, flax, and the dry residues of beets and potatoes, as well as in soils rich in organic matter, and he concludes that it is an important constituent in the majority of plants.—W. H. B.

Studies on the action of strongly diluted hydrochloric acid and of pepsin and hydrochloric acid on the digestible albuminoids in various foods and feeding stuffs, A. STUTZER (*Landw. Vers. Stat.*, *40*, *pp. 161–175*).—This is a continuation of investigations reported by the author under the same title in *Landw. Vers. Stat.*, 37 (1890), pp. 107–133. The question to be investigated was whether in the testing of different feeding stuffs the digestible albuminoids contained therein are dissolved by pepsin and hydrochloric acid with the same rapidity, or whether the solubility of albuminoid bodies in different feeding stuffs is different.

The earlier report was largely occupied with a description of the author's method of fractional digestion. In this determinations are made in the substance tested of the total nitrogen, the amide nitrogen, and the nitrogen dissolved in pepsin-hydrochloric acid solution after deducting the amide nitrogen.

Further studies reported in the present article indicated that for these experiments the digestive fluids need not be freshly prepared, but might be several months old without harm in case they had been closely stoppered and kept in a cool place away from the direct rays of the sun; and that in studies on peanut cake, rice feed, and cocoanut cake the result was the same whether the substance was very finely ground or whether the particles were 0.5 to 1 mm. in size. Dried diffusion residues and hay were more digestible in a finely ground condition than when coarser. In the case of coarse fodders, therefore, the material should be finely ground.

The experiments reported in the present article were on peanut cake, rice feed, cocoanut cake, dried diffusion residues, and hay. These studies showed the rapidity with which the digestible albuminoids contained in different feeding stuffs were dissolved by pepsin and hydrochloric acid to be very different. This difference is traced to specific peculiarities of the different albuminoid substances. Setting aside the individual differences in the case of different animals, it is believed to be possible by means of the method of fractional digestion worked out

to determine with reasonable accuracy whether the albuminoids contained in this or that feeding stuff are more difficultly or more easily digestible; also whether by different means of preparation, as cooking, steaming, drying, ensiling, etc., or by the addition of salt, preservatives, etc., the original digestibility of the albuminoids is favorably or unfavorably affected. The new method it is hoped will be of no less value in the investigation of human foods than in testing the value of animal foods. It is self-understood that the method follows only the purely chemical course of digestion and also that the results of this "fractional" digestion give no absolute figures but only comparative ones. The disadvantageous effect of salicylic acid and saccharine and the indifferent action of thymol on digestion of the protein have been alluded to in other places. The action of certain organic acids has also been studied (E. S. R., vol. II, p. 525). Later experiments show the high value of lactic, malic, tartaric, and citric acids and the very low value of acetic and butyric acids. For the action of common salt see E. S. R., vol. II, p. 526. The experiments formerly made by G. Kühn and U. Kreusler, showing the disadvantage of steaming and cooking feeding stuffs as regards the digestibility of the albuminoids, have been corroborated. The baking of flour in bread renders the albuminoids more difficultly digestible, while the starchy constituents are made more easily digestible by this process. In experiments here reported and in others the author has found invariably that the heating of substances up to that temperature at which the albuminoid bodies coagulate renders them more difficultly digestible. The difference is still more marked when instead of pepsin solution the solvents are pure water and acidulated water. The diminished solubility of the albuminoids is believed to be attributable to the fact that these bodies can act as ferments, and by heating this fermentative action is destroyed. Numerous observations favor this theory. The results already obtained give encouragement for the hope that by this means of "fractional" digestion much may be learned regarding the behavior of albuminoids under the influence of the digestive fluids.—E. W. A.

The digestibility and the nutritive value of cellulose, N. ZUNTZ (*Arch. ges. Physiol., 49, pp. 477–481; abs. in Centralbl. agr. Chem., 21, pp. 88–90*).—Recent experiments at the Göttingen Station have indicated crude cellulose to be of equal or nearly equal feeding value to starch and sugar. Wolff, on the contrary, found crude fiber to be of inferior feeding value in experiments with work horses, and experiments on the horse by the author and his associates have also pointed in the same direction. The author found that the consumption of oxygen by an animal kept perfectly quiet was greater the larger the amount of crude fiber in the food. He explains this in part by the increased work required for digestion of the more voluminous fodder, and in part by the lower value observed by J. Munk and Mallèvre for cellulose. The discrepancy between these results and those with sheep in the

Göttingen experiments he believes to be explained by the difference between the digestive organs of the horse and ruminants and the difference in the place where the cellulose fermentation takes place. In the case of the horse all of the albuminoid bodies, carbohydrates, and fat accessible to the digestive fluids are dissolved in the stomach, and principally resorbed there. Only the cellulose and the food materials which are encased in cell membranes not ruptured in chewing, pass on into the cæcum and colon. Here the cellulose undergoes fermentation and a large part is rendered soluble, and the resulting organic acids are resorbed. The other food nutrients are also believed to be largely rendered soluble by the solution of the cell membrane surrounding them, and resorbed, but are by no means absorbed to the same extent as if they had been set free at an earlier stage, since the power of resorption in this part of the apparatus is much weaker than in the small intestines. In the case of ruminants, on the other hand, a large part of the crude fiber is dissolved in the first three stomachs. The existence of these three stomachs presents the advantage that by an earlier breaking open of the cell membrane the contents are exposed to the digestive fluids, and the disadvantage that much valuable food material is decomposed and diminished in value by the process of fermentation. Tappeiner found that in the presence of the characteristic microbes starch and sugar undergo the same decomposition as crude fiber, and that they thus in a measure prevent the cellulose from being acted upon by the germs. He concluded from this that the cellulose digestion suffered from the presence of excessive amounts of soluble carbohydrates and explained in this way the so-called depression in digestibility in ruminants attributed to these soluble carbohydrates. He found that the presence of large amounts of albuminoids increased the intensity of the fermentation by which cellulose was rendered soluble, and so made the decomposition of the cell membrane possible even in the presence of large amounts of soluble carbohydrates.

The above accounts for the apparent equality of the feeding value of cellulose and starch in the case of ruminants. The starch, and especially the sugar, may ferment in place of the cellulose, and so themselves be reduced in value; they are in part lost in the form of marsh gas and organic acids. Under given conditions of fermentation certain amounts of marsh gas, carbonic acid, acetic acid, etc., are produced. The conditions of fermentation remain the same as long as the relation of the carbohydrates to the albuminoid bodies and salts in the fermenting mass remains unchanged. When the amount of crude fiber falls below a certain minimum the intensity of the fermentation suffers because of a certain catalytic action, attributed by Tappeiner to crude fiber, by which the intensity of this particular fermentation is increased, and because the sojourn of the food in the first three stomachs for a sufficient length of time is believed to depend upon the presence of cellulose.

The results of the Göttingen experiments agree with this view. The

amount of marsh gas given off by the animals remained unchanged when a part of the crude fiber of the food was replaced by an equivalent amount of starch. In the experiments with horses the amount of marsh gas given off was not determined.—E. W. A.

Observations on dried brewers' grains, A. STUTZER (*Landw. Vers. Stat., 40, pp. 311–316*).—Wet brewers' grains are submitted to intense pressure before drying, which removes a large amount of a cloudy liquid. The amount of liquid expressed was found to be about 100 liters per 1,000 kg. of wet grains. One hundred liters of this liquid was found to contain 1.15 kg. of protein, 3.57 kg. of cellulose and nitrogen-free extract, and 0.6 kg. of ash. This is calculated to be a loss of 1.45 pounds of protein, 5 pounds of nitrogen-free extract, 0.33 pound of phosphoric acid, and 0.42 pound of calcium oxide per 100 pounds of dried grains containing 10 per cent of moisture.

Tests were made artificially of the digestibility of the protein in purchased samples of dried brewers' grains and in samples which were carefully dried in the laboratory. In the case of the samples dried in the laboratory the percentage of amide nitrogen was higher and the pepsin-soluble nitrogen was very much more easily soluble in the digestive fluids than in the commercial dried grains. The inference is that carelessness in drying may impair the nutritive value of the grains.—E. W. A.

The physiological effect of corn cockle when fed to swine, C. KORNAUTH and A. ARCHE (*Landw. Vers. Stat., 40, 177–202*).—The conflicting opinions of scientists and practical farmers as to the feeding value of corn cockle and the danger attending its use, led the authors to undertake an investigation as to the actual physiological effect of this plant on swine. The refuse from the machines used in cleaning grain (*Trieurausputz*) is said to consist for the greater part of cockle seed. Especially is this the case in Hungary, and there the refuse is very extensively used in fattening pigs. The seeds are said to be poisonous. H. Schultze isolated an alkaloid from them. Ulbricht fed an extract supposed to contain the alkaloid to two rabbits, with the result that both died of paralysis of the heart within twenty-four hours. Pusch, who made an extensive study of the subject, summed up his results in substance as follows: Under certain conditions corn cockle is injurious to domestic animals. The amount of the poisonous substance in the seed is variable, depending probably upon the season and the soil. Animals become accustomed to it, so that amounts of seed which at first caused sickness, later have no injurious effect. The susceptibility of animals to the poison varies both with the species and the individual. Young animals are more readily affected than older ones. It is believed that rodents and sheep are not susceptible, and as far as known grown cattle are only slightly or not at all affected by the poison. Calves, swine, horses, and especially dogs are more or less susceptible. Concerning birds and fowls there is some doubt.

The present experiments were made on rabbits and pigs at the

Vienna Station. Two rabbits were fed refuse containing 46 per cent of cockle for a period of thirty-six days, and then the cockle seed alone for thirty days, without apparent injurious effect in either case. Injections were then made under the skin of variously prepared aqueous and alcoholic extracts of cockle seed, representing from 14 to 20 grams of the seed, but without apparent effect on the health of the rabbits. Negative results were likewise obtained with a bread containing 40 per cent of cockle-seed meal, which was eaten by grown persons and children.

Three pigs, weighing at the beginning from 48 to 70 pounds, were fed a nearly pure cockle seed (95.6 per cent). mixed with from 30 to 60 per cent of barley and corn. All gained rapidly except one, which was a poor feeder and which received 70 per cent of cockle seed. This pig was slaughtered at the end of two months and an examination made, but the alimentary canal was found to be in every respect normal. The other two pigs were then placed in a respiration apparatus to observe the effect of the cockle seed on the metabolism. In the first period (March 15–25) the food consisted, as before, of a mixture of cockle seed, barley, and corn, and in the second period (April 4–14) the cockle seed was replaced by oil cakes. The experiment was carried out in the usual manner and permitted the estimation of the amounts of albuminoids, fats, and carbohydrates digested, and of albuminoids and fat stored in the body with each ration. The outcome of this part of the investigation was in brief as follows: The feeding of cockle seed to young pigs in the proportion in which it is present in the refuse from grain-cleaning machines was not attended by any perceptible disadvantageous effects either on the health of the animals or the manner in which the food was used in the body. Where 70 per cent of the food was cockle seed the increase in live weight was small, but this is believed to be due to the bitter taste of the seed and the reluctance with which the pigs ate it rather than to any poisonous action. The cockle seed slightly diminished the storage of albuminoids in the body (formation of lean meat), but tended to increase that of the fat. The latter was indicated by the diminished amount of carbonic acid exhaled when the cockle seed was fed. There was little difference between the digestibility of the cockle-seed ration and of the other. The lean meat produced on cockle feed was normal in composition and character. A larger amount of the cockle-seed ration was required to produce an increase of 100 pounds in live weight than of the oil-cake ration, but this was more than compensated for by the lower price of the cockle seed. The authors conclude, therefore, that cockle is to be regarded as a harmless and valuable food for growing pigs.—E. W. A.

The poisonous effects of corn cockle, KOBERT (*Landw. Centralbl. Provinz Posen, 19; abs. in Centralbl. agr. Chem., 21, p. 273*).—According to the author, corn cockle contains a substance, saponin, which acts as a poison either when introduced into the blood or when

eaten in the form of cockle seed. Healthy rats and rabbits can withstand the poisonous effects of the seed for some time. Dogs, cats, and birds are much more susceptible to it, and after being fed on the seed a short time become sick and die. It is also injurious to swine and cattle and may induce death. The poison decomposes the blood, dissolving the red corpuscles, and also destroys the sensitive albuminoid portion of the nerve elements. In view of the injurious effects of cockle seed, he thinks the sale of feeding stuffs containing admixtures of cockle seed should be prohibited by law. He believes that grain should be thoroughly cleaned of cockle seed by machinery before grinding.

The poisonous principle is said to lie just under the surface of the seed, and he suggests that cockle seed may be prepared for feeding by coarse grinding so that the outer covering can be separated, and then heating the latter in iron pans at 50° C. The heat decomposes the poisonous substance, and the whole may then be ground and mixed with grain feeds without danger.—E. W. A.

Is sterilized milk more difficult to digest than raw milk? A. STUTZER (*Landw. Vers. Stat.*, *40*, *pp. 317-319*).—Raudnitz* found in experiments with dogs that cooked milk was slightly less digestible than uncooked milk. The author studied the matter by means of "fractional" digestion experiments. He used milk which had been sterilized according to Sohxlet's method in bottles of 200 c. c. capacity by heating for one hour. Four separate experiments were made with sterilized and four with unsterilized milk. The results, in agreement with those found by Raudnitz, showed the uncooked milk to be somewhat more rapidly digested by the artificial digestive fluids than the sterilized milk.—E. W. A.

Studies on butter fat, M. SCHRODT and O. HENZHOLD (*Landw. Vers. Stat.*, *40*, *pp. 299-309*).—The authors have previously reported under the same title† a series of investigations which were made to observe the range of variation of the volatile and the insoluble fatty acids and of olein in butter. These studies were made on the butter produced from the milk of one Angler cow, and of a herd of ten cows, including Angler, Breitenburger, and Shorthorn-Ditmarscher breeds, and lasted a year, samples being analyzed twice every week. The conclusions were that the amounts of volatile and insoluble fatty acids and of olein in butter were governed by the stage of the period of lactation and not by the nourishment of the cows, whether winter stall feeding or summer pasturage, which had no part in the changes in the composition of the butter fat. With the advance of the period of lactation the volatile acids were found to decrease, while the percentage of insoluble acids and of olein increased. The index of refraction of the fat suffered only slight variations, which apparently were due neither to the period of lactation nor to the food. On the basis of their studies the authors recommended that

* Zeitsch. f. physiol. Chem., 14, p. 114.

† Landw. Vers. Stat., 38, pp. 349-371.

when in the examination of butter for admixtures of foreign fats a low content of volatile acids is found, the insoluble acids be determined also, the range of variation of which is small. For pure butter which shows a low content of volatile fatty acids has a high content of insoluble fatty acids, and the addition of a small amount of foreign fats will suffice to raise the insoluble acids in the mixture above the maximum limit for pure butter. The refractive index was also recommended, being rapidly determined and furnishing valuable indications.

In a further study of the same subject the authors extended their observations to the butter made from the mixed milk of a herd of 220–230 cows on an estate in eastern Holstein, receiving samples of butter direct from the creamery twice weekly from May 3, 1890, to May 23, 1891. In each sample the volatile and insoluble fatty acids and the index of refraction were determined, the latter by means of the Abbé refractometer. All determinations were made in duplicate.

The cows were a cross of Angler and Ayrshire breeds. They were turned to pasture May 7, 1890, and remained until the last of October. The stall feeding lasted from the latter date to May 21, 1891, during which time they received per head daily about 5 pounds meadow hay, 10 pounds straw (oat and barley), 3 pounds of a mixture of ground oats, barley, and peas, 1 pound of wheat bran, 2½ pounds of palm cake, and 1½ pounds of peanut cake. In 1889–'90 sixty-six cows of the herd calved between October and December, eighty-five between January and March, and the remainder from April on. In 1890–'91 sixty-three cows calved between November and January, ninety-seven between February and April, and the rest later. In accordance with this the majority of the cows would be old in milk from July to October.

The cream was raised by a centrifugal separator and churned sour. The average composition of the butter as compared with that found in the previous investigation with 10 cows is given as follows:

Averages, and range of variation.

Year.	Average for year.			Range of variation.		
	Volatile fatty acids.	Insoluble fatty acids.	Index of refraction.	Volatile fatty acids.	Insoluble fatty acids.	Index of refraction.
	*c. c.**	*Per cent.*		*c. c.**	*Per cent.*	
1890–'91	26.162	88.328	1.4586	21.54–28.94	86.95–90.29	1.4560–1.4620
1889–'90	29.570	87.880	1.4592	23.60–34.02	85.36–89.76	1.4580–1.4620

* Of deci-normal soda solution.

The volatile acids, as will be seen, were unusually low. The authors think that this can not have been due to the food, but suggest that the breed of cows may have some connection with it.

The following are the averages by months of the results found:

Averages by months.

Months.	Volatile fatty acids.	Insoluble fatty acids.	Index of refraction.
1890.			
	*c. c.**	*Per cent.*	
May	27.78	88.32	....
June	26.45	88.61	....
July	24.32	88.77	1.4589
August	24.35	87.84	1.4584
September	23.73	88.59	1.4604
October	22.46	89.58	1.4616
November	26.53	88.39	1.4589
December	27.16	87.65	1.4581
1891.			
January	27.49	87.64	1.4583
February	28.05	87.79	1.4577
March	28.22	87.46	1.4577
April	27.87	88.47	1.4574
May	25.92	89.13	1.4565

* Of deci-normal soda solution.

During the months from July to October, inclusive, when a large majority of the cows were in an advanced stage of the milking period, there was a decrease in the content of volatile acids in the butter, the lowest point being reached in October. In November, when 20 cows calved, a sudden increase is noticed. When the months during which the volatile acids were low and during which they were high are each averaged, a connection is seen between the content of volatile and of insoluble acids, the latter being highest when the volatile acids are low. The authors believe the effects of the period of lactation on the content of volatile and insoluble fatty acids in the butter are plainly visible, and that the results confirm their previous observations. The highest index of refraction falls in the months when the volatile acids are lowest (September and October). No increase in volatile acids seems traceable to the effect of the change from stall feeding to pasturage.

Reference is made to Swaving's observations on Holland butter,* from which the conclusion was drawn that the formation of volatile fatty acids is dependent on the food as well as on the period of lactation, and that these acids increase or are maintained at a high point with the beginning of the pasturage season and of a new period of lactation. The authors hold that the data presented by Swaving do not justify the conclusion that the volatile acids are affected by the food.

The final conclusions from the studies are that (1) the content of volatile fatty acids in butter fat is dependent upon the stage of lactation and is not affected by the food. With the advance of the milking period these acids gradually diminish. (2) As a rule a lower content of volatile acids is accompanied by a higher percentage of insoluble acids and the latter by an increased index of refraction. (3) Some butters are characterized by a low amount of volatile fatty acids. The

*Landw. Vers. Stat., 39, pp. 127–141 (E. S. R., vol. III, p. 125).

cause of this is far from being clear. (4) In consequence of the low content of volatile acids which may occur in true butter their determination alone is insufficient in butter inspection. Determinations of the insoluble acids and the index of refraction are recommended.—E.W.A.

On the proportion of water in butter, A. H. ALLEN (*Analyst, 1892, pp. 107–109*).—"A good deal of interest is attached at present to the proportion of water which may be properly contained in butter in consequence of the sudden appearance in the market of butters containing an unusually large percentage of water." In 1877 the author noticed 19.83, 22.24, and 25 per cent of water in three samples of suspected butter submitted to him for analysis. Recently he has found over 20 per cent of water in several cases, one sample containing 29 per cent. These were regarded as adulterated with water. Dr. Bell is quoted as stating in his work on food that "a greater amount of water in butter than 12 per cent is unnecessary, so far as attaining a good appearance is concerned, and anything over 16 per cent is injurious to the keeping qualities of the butter." More recently he gives the maximum for water at "about 18 per cent." In 1875 the Society of Public Analysts proposed and adopted as a standard for butter 80 per cent of butter fat, leaving 20 per cent for water, salt, and curd. This the author regards as "a perfectly proper limit."

The author describes his method of determining water in butter as follows:

I find the proportion of water in butter to be most conveniently determined by placing 5 grams of the sample in a small tared beaker and exposing it in an air bath to a temperature not exceeding 110° C., until no more globules of water can be observed on looking at the beaker from below. Generally the water can be completely expelled in about one hour. The curd and salt can be subsequently determined in the same quantity. After evaporating the water the fat is remelted and filtered into a small beaker kept in the water oven. The residual matter is rinsed onto the filter with redistilled petroleum spirit and washed with petroleum spirit until free from fat. The filter is then dried at 100° C., and the contents scraped off and weighed. After weighing, the residue, which represents the curd and salt of the butter, may be examined under the microscope for starch, cellular tissue, etc., and then, if desired, treated with cold water, and the solution further examined or titrated with standard silver solution to estimate the salt. Usually, however, it is sufficient to ignite the residue in porcelain at a low temperature and regard the non-volatile matter as salt and the combustible as curd.

Some butters are far from being homogeneous, and when possible it is preferable to work on 25 to 50 grams rather than on smaller quantities.

In the discussion which followed the reading of the above paper, Mr. Hehner said that in his opinion there was no reason why butter should contain more than 13 per cent of water. When the percentage of water rose above 15 it was either culpably added or negligently left in, and the excess was not only detrimental to the public but to the butter merchants themselves. He had been told by a merchant that in a consignment from a particular farmer, out of every hundredweight of butter he lost from 3 to 4 pounds in transit, while in ordinary butters the loss

was only from one third to one half a pound. On analyzing a sample of the butter referred to, it was found to contain 18.8 per cent of what the Irish inspectors would call "undissolved water."

Mr. Stokes claimed that under the microscope it could readily be seen whether a sample contained margarine or whether it contained an abnormal amount of water. He took the butter just as it came to him and scraped a large surface clear. He then took a thin layer below this and placed it on an ordinary microscope slide; over that he placed a microscopic cover glass, and pressed this down so that the butter formed a thin wedge. He now crossed the polarizing prisms so that the field of view was absolutely dark. On placing the slide between the prisms, if there was a trace of butterine or margarine, say within 10 per cent, at once a glimpse of light came through. Badly constructed polariscopes let light pass without interposing an object and are useless for this purpose. In the case of a genuine butter there was no illumination at all. He had never once found this system to fail. No selenite should be used since its results are often delusive. He relied solely on the microscopic examination in inspecting butters.

Objections were raised to relying exclusively on any single test of the purity of butter.—W. H. B.

The detection of margarine in butter, H. RODEWALD (*Land. Vers. Stat., 40, pp. 264–275*).—The author points out that while butter differs from margarine in chemical composition the difference is a quantitative rather than a qualitative one, for margarine gives all the qualitative reactions known to butter. Thus margarine as well as butter contains volatile and insoluble fatty acids, absorbs iodine, and refracts the plane of light. To make use of these reactions in judging of the purity of butter, the maximum and minimum numbers for absolutely pure butter must be worked out. In this connection he refers to the valuable contributions of Schrodt and Henzhold.* Using these figures as standards, a comparison with them of the figures found for any sample of butter will furnish indications which will enable the chemist to judge of its purity; but however firmly convinced the chemist may be that the sample is adulterated with margarine, with the present data and methods absolute certainty on that point can not be had. Further investigations may give new maximum and minimum values. In other cases the chemist may feel convinced that the sample is an adulterated article, although the fatty acids, iodine number, and index of refraction are all within the range found for pure butter. It is impossible in such and similar cases to fix upon the probability of adulteration by a mere comparison of the values found with the maxima and minima. The author proposes a method by which the degree of probability of adulteration is calculated and expressed numerically, the degree being always a fraction of one. The data required are, (1) the volatile fatty acids, expressed in c. c. of deci-normal sodium hydrate; (2) the insoluble

*Landw. Vers. Stat., 38, p. 349.

fatty acids, expressed in per cent by weight; (3) the iodine number, *i. e.*, the grams of iodine absorbed by 100 grams of fat; and (4) the index of refraction determined by the Abbé refractometer at 22° C. The author uses as standards the average values found by Schrodt and Henzhold in their examinations of 105 samples of butter, that is, volatile fatty acids 29.59 c. c., insoluble fatty acids 87.88 per cent, iodine number 35.39, and refractive index 1.4592. The "probability of adulteration" is calculated by means of the method of least squares.—E. W. A.

Behavior of butter and margarin towards coloring matters, M. WEILANDT (*Milch Ztg., 1892, pp. 238–241*).—The coloring stuffs employed were indigo, aniline, picric acid, eosin, fuchsine, and methylene blue, in the hope of finding a reaction for detecting the presence of small admixtures of margarin in butter. The method of procedure was to add a small quantity of the coloring matter to the melted and filtered fat (pure butter or margarin or mixtures of the two) while still hot, and after filtering and allowing to stand for a time, to observe the result both in respect to the color reaction and the amount of coloring matter which had been absorbed by the fat. The reactions which gave the most promise were with eosin and with methylene blue.

With eosin pure butter gave a reddish-brown color, changing to dark orange when heated and filtered, and to cherry with sodium hydrate; the solution in ether was dark cherry-colored, and became colorless when much ether was added, but the cherry color was reproduced by sodium hydrate. Pure margarin was dark red with the reagent, but the color changed to "chamois" on standing a day, and became straw-colored when heated and filtered; the solution in ether was colorless, and there was no perceptible reaction with sodium hydrate. Mixtures of margarin and butter were distinguished from pure butter, but it was difficult to detect as small an admixture as 5 per cent of margarin with anything like certainty. This reaction is to receive further attention in the hope of perfecting it.

With methylene blue, pure butter gave a deep (*russisch*) green when hot, changing to a light bluish green on cooling, while margarin gave an olive when hot, changing to a yellow on cooling. The difference in color is said to be very marked. Mixtures of butter with 5 and 10 per cent of margarin, respectively, which were colored with methylen blue, heated for a few minutes with concentrated nitric acid, and then thoroughly shaken, exhibited the following colors when cold:

Pure butter	bluish green.
Pure butter with 5 per cent margarin	light violet.
Pure butter with 10 per cent margarin	dark violet.

The amount of methylene blue absorbed by butter and by mixtures of butter and margarin was determined. This was done in two ways: By dissolving the coloring matter from the ether solution of fat with warm water and weighing the extract, and by oxidizing the sulphur in the methylene blue to sulphuric acid by means of hot nitric acid and

determining the sulphuric acid with barium chloride. By the first method the following amounts of methylene blue were found to be dissolved per 100 c. c. of fat:

	Gram.
Pure butter	0.1180
Pure butter with 5 per cent margarine	0.0133
Pure butter with 10 per cent margarine	0.0413
Pure butter with 20 per cent margarine	0.0373

The second method indicates the following amounts of methylene blue per 100 c. c. of fat:

	Gram
Pure margarine	0.0954
Pure margarine	0.0976
Pure butter	0.1097

The results encourage the author to believe that from either the color reaction with eosin or the gravimetric determination of the methylene blue absorbed a reliable method for the recognition of margarine may be worked out.—E. W. A.

Composition of overripe cheese, A. MAGGIORA (*Arch. f. Hygiene, 14, pp. 216–224*).—Microscopic and chemical studies were made on three samples of *strachino* (*Gorgonzola*), an overripe cheese largely consumed in northern Italy. The samples represented different stages of overripeness. Sample No. 1 was the least putrid of the three. It was soft and lardy, supported an extensive growth of *Penicillium glaucum*, and contained a few maggots and a grayish soft liquid mass in the pores. No. 2 was very much changed, and had become nearly an amorphous mass, viscous in places, and contained large numbers of maggots. The taste is described as "caustic but not unpleasant." No. 3 had been placed in a glass-stoppered bottle soon after becoming ripe and kept for about seven months. At the end of that time it was of a dark yellow color, soft, viscous, and had a strong, caustic taste. The microscopic examinations of the samples showed that as the cheese became more overripe the number of fat globules diminished, crystals of fatty acids, leucin, and tyrosin became numerous, and the number of bacteria, insect eggs, fungi, etc., very materially increased. Analysis gave the following results:

Composition of overripe cheese.

	Sample No. 1.	Sample No. 2.	Sample No. 3.
	Per cent.	*Per cent.*	*Per cent.*
Water	31.410	32.430	37.630
Fat	37.520	34.080	36.190
Total nitrogen	4.280	4.150	4.311
Albuminoid nitrogen	2.592	1.273	0.580
Amide nitrogen	1.011	1.493	1.876
Nitrogen as ammonia	0.677	1.264	1.855
Crude protein	26.750	25.937	26.940
Albuminoids	16.200	7.956	3.625
Crude ash (less NaCl)	2.743	5.778	9.545
Common salt	1.332	0.990	0.917

The unusually large percentage of ash in samples 2 and 3 is said to be due to an artificial rind of gypsum used to preserve the form of the cheese. The decomposition of the cheese was accompanied by a formation of fatty acids from the fat globules. The quantity of potassium hydrate required to neutralize these acids was, No. 1, 29.01 c. c.; No. 2, 37 c. c.; No. 3, 49.53 c. c. The acid number of a sample of the same kind of cheese soon after making was 1.7, and of another ripened sample 22.4. While the total nitrogen is nearly the same in the three samples, the form in which it is present varies widely. The albuminoids decrease and the amides and ammonia increase as the cheese ages, large quantities of leucin, tyrosin, and ammonium salts being formed at the expense of the paracasein. The cheese loses in nutritive properties as overripening progresses, until finally it may become little else than an aqueous solution of fatty acids (free or saponified by ammonia), leucin, tyrosin, mineral salts, and a mass of bacteria and fungi whose protoplasm probably furnishes the main if not the entire amount of the albuminoids found.

At the close of the article the author describes the methods of analysis followed, which are those ordinarily employed in analysis of cheese.—E. W. A.

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The culture and treatment of tobacco (*Ueber den Bau und die Behandlung des Tabaks*), J. NESSLER.—*Landw. Vers. Stat., 40, Heft 5 and 6, pp. 395–438.*

On tobacco seed and the raising of young plants (*Ueber Tabaksamen und Anzucht der Setzlinge*), E. BEINLING and J. BEHRENS.—*Landw. Vers. Stat., 40, Heft 5 and 6, pp. 339–349.*

Effect of seed potatoes from more or less prolific plants on the yield (*Einfluss der Saatkartoffeln von mehr oder minder fruchtbaren Stauden auf die Kartoffelerträge*), BRUMMER.—*Deut. landw. Rundsch., 1891, p. 301; abs. in Centralbl. agr. Chem., 21, Heft 7, p. 467.*

Analyses of healthy and diseased sugar cane (*Analysen von gesundem und krankem Zuckerrohr*), A. STUTZER.—*Landw. Vers. Stat., 40, Heft 5 and 6, pp. 325–327.*

Investigations on the needs of the vine (*Recherches sur les exigences de la vigne*), A. MÜNTZ.—*Compt. rend., 114 (1892), No. 25, pp. 1501–1504.*

Recent experiments in combatting potato blight (*Nouvelles expériences sur les moyens de combattre la maladie de la pomme de terre*).—*Bul. Sta. Agron. à Gembloux, No. 50, pp. 6.*

Bacteriological investigation of the wet rot of potatoes (*Bakteriologische Untersuchungen über die Nassfäule der Kartoffelknollen*), E. KRAMER.—*Oesterr. landw. Centralbl., 1 (1892), Heft 1, pp. 11–26.*

The Califoinia vine disease (Plasmodiophora californica) (*Sur la maladie californie, maladie de la vigne causée par le Plasmodiophora californica*), P. VIALA and C. SAVAGEAU.—*Compt. rend., 115 (1892), pp. 67–69.*

On the brown blight of the vine (*Sur la brunissure, maladie de la vigne causée par le Plasmodiophora vitis*), P. VIALA and C. SAVAGEAU.—*Compt. rend., 114 (1892), No. 26, pp. 1558–1560.*

A simple method for approximately determining the extent of adulteration

of peanut cake and peanut meal (*Ueber ein einfaches Verfahren, Verfälschungen von Erdnusskuchen und Erdnussmehlen annähernd quantitativ zu bestimmen*), L. HILTNER.—*Landw. Vers. Stat., 40, Heft 5 and 6, pp. 351–355.*

Decrease in value of oil cake by overheating (*Nachweis einer Wertverminderung der Oelkuchens durch zu starke Erhitzung*), A. STUTZER.—*Landw. Vers. Stat., 40, Heft 5 and 6, pp. 323, 324.*

Is raw meat more rapidly digested than cooked meat? (*Wird rohes Fleisch schneller verdaut als gekochtes?*) A. STUTZER.—*Landw. Vers. Stat., 40, Heft 5 and 6, pp. 321, 322.*

Relative feeding value of grass cut at different periods of growth, M. J. SUTTON and J. A. VOELCKER.—*Jour. Bath and West and Southern Counties Soc., 2, ser. 4.*

Six years of experience with silage (*Sechsjährige Erfahrungen über Grünpressfutter*), FREIHERRN PERGLER VON PERGLAS-HOF.—*Deut. Landw. Presse, 1892, No. 51, p. 551.*

Difference in the nutritive effect of raw and cooked milk (*Ueber den Unterschied der Nährwirkung roher und gekochter Milch*), WASILEFF-PETERSBURG.—*Molkerei Ztg., 1892, No. 7; abs. in Vierteljahressch. Chem. Nahrungs- u. Genussmtl., 1892, Heft 1, p. 9.*

Behavior of sterilized milk to the digestive fluids of the stomach (*Verhalten sterilisirter Milch zum Magensafte*), ELLENBERGER and HOFMEISTER.—*Molkerei Ztg., 1892, No. 6; abs. in Vierteljahressch. Chem. Nahrungs- u. Genussmtl., 1892, Heft 1, p. 9.*

Effect on live weight and general health of cows and on quantity and quality of milk of providing automatic watering troughs in stalls, allowing cows to drink at will (*Versuche über die Wirkung automatischer Tränken*), BACKHAUS.—*Milch Ztg., 1892, No. 30, pp. 509–513.*

Feeding trials with "aleuronat" (*Fütterungs-Versuche mit Aleuronat*), C. KORNATH.—*Oesterr. landw. Centralbl., 1 (1892), Heft 5, pp. 12.*

Feeding experiments at experiment stations in North America (*Nordamericanische Versuchs-Stationen Fütterungs-Versuche*), M. WILCKENS.—*Jour. Landw., 40, Heft 2, pp. 185–212.*

Nutrition with carbohydrates and meat or with carbohydrates alone (*Die Ernährung mit Kohlenhydraten und Fleisch oder auch mit Kohlenhydraten allein*), E. PFLÜGER.—*Pflüger's Arch., 52, pp. 239–322; abs. in Chem. Centralbl., 1892, II, No. 2, p. 90.*

Effect of different food on the water content of the organs and on the hemoglobin content of the blood (*Ueber den Einfluss verschiedener Nahrungsmittel auf den Wassergehalt der Organe und den Hämoglobingehalt des Blutes*), C. VOIT.—*Sitzungsber. math. physikal. Cl. Akad. Wissensch. zu München, 1892, 21; abs. in Chem. Ztg., 1892, Repert., p. 213.*

Excretion of nitrogen in urine (*Ausscheidung des Stickstoffs im Harn*), GUMLICH.—*DuBois-Raymond Arch. Physiol., 1892, pp. 164–166; abs. in Chem. Centralbl., 1892, II, No. 2, p. 93.*

In what form does phosphoric acid appear in urine? P. CARLES.—*Jour. Pharm. et Chim., ser. 5, 25, pp. 497–499; abs. in Chem. Centralbl., 1892, II, No. 2, p. 88.*

Bees and apiculture (*Ueber die Biene und deren Zucht*), E. RATHLEF.—*Balt. Wochensch. Landw., etc., 1892, No. 28, pp. 401–411; No. 31, pp. 441–445, and No. 31, pp. 441–445.*

On the secretion of milk and the observations made at Kleinhof-Tapiau (*Ueber Milchabsonderung und die in Kleinhof-Tapiau gemachten Beobachtungen*), W. FLEISCHMANN.—*Königs. land- u. forstw. Ztg.; abs. in Landw. Ann. meckl. pat. Ver., 1892, No. 24, pp. 191–194, and No. 25, pp. 200–203.*

Estimation of the productiveness of cows (*Ueber Ermittelung der Leistungsfähigkeit der Milchkuh*), BACKHAUS-GÖTTINGEN.—*Deut. landw. Presse, 1892, No. 48, pp. 519, 520, and No. 51, pp. 552, 553.*

Paying for milk on the basis of its fat content, and the calculation connected therewith (*Einiges über Bezahlung der Milch nach Fettgehalt und die sich daran anschliessenden Berechnungen*), W. MUND.—*Molkerei Ztg., 1892, No. 29, pp. 345, 346.*

Causes which effect the raising of cream (*Einige Ursachen die das Aufsteigen des Rahmes verändern*), LIEBIG.—*Molkerei Ztg., 1892, No. 2; abs. in Vierteljahressch. Chem. Nahrungs- u. Genussmtl., 1892, Heft 1, pp. 7–9.*

The dairy industry in Italy (*Das Molkereiwesen in Italien*), A. NENTWIG-GLATZ.—*Molkerei Ztg., 1892, No. 31, pp. 373, 374; No. 32, pp. 387, 388; and No. 33, pp. 401, 402.*

A study of the constitution of milk—is it acid or alkaline? (*Étude sur la constitution du lait, le lait est-il acide ou alcalin?*), L. VANDIN.—*Bul. Soc. Chim. de Paris, 7–8 (1892), ser. 3, No. 14, pp. 483–492.*

Killing the pathogenic bacteria in milk by electricity, DUBOUSQUET-LABORDERIE.—*Abs. in Milch Ztg., 1892, No. 28, p. 473.*

Analyses of English cheeses, A. B. GRIFFITHS.—*Bul. Soc. Chim. de Paris, 7–8, ser. 3, No. 10, p. 282.*

Increase in the manufacture of margarine in Holland (*Die Ausbreitung der Margarin-Fabrikation*).—*Landw. Ztg. das nordw. Deutschland, 1891, No. 20, p. 81; abs. in Centralbl. agr. Chem., 21, Heft 5, p. 429.*

Bacteriological studies of some milk and butter defects, C. O. JENSEN.—*22 Beretning fra den Kgl. Veterin og Landbohöjsk. Lab. f. landökonom. Forsög. Kopenhagen, 1891, pp. 15–67; abs. in Chem. Centralbl., 1892, II, No. 2, p. 75.*

Earth worms and tuberculosis (*Vers de terre et tuberculose*), LORTEL AND DESPEIGNES.—*Compt. rend., 115 (1892), No. 1, pp. 66, 67.*

Chemical examination of the microbes causing inflammation of mammary glands of cows and goats, W. NENCKI.—*Arch. de scienc. biolog. de l'Inst. imp. de méd. expérim. de St. Pétersbourg, 1892, p. 25; abs. in Chem. Ztg., 1892; Repert., p. 214.*

Report of the experiment station at Rostock, Germany, for the year 1891 (*Thätigkeitsbericht der landw. Versuchs-Station für das Jahr 1891*), HEINRICH.—*Landw. Ann. meck. pat. Ver., 1892, No. 26, pp. 207–209.*

EXPERIMENT STATION NOTES.

CALIFORNIA STATION.—Director Hilgard has been granted leave of absence for one year from June 15, 1892, and E. J. Wickson has been appointed acting director in his absence.

COLORADO COLLEGE AND STATION.—F. A. Huntley, B. S. A., assistant agriculturist at the college, and F. L. Watrous, superintendent of the Arkansas Valley Substation at Rocky Ford, have exchanged positions.

CONNECTICUT STORRS STATION.—In the absence of W. O. Atwater, Ph. D., director of the station, C. D. Woods, B. S., will be acting director. E. A. Bailey, assistant agriculturist, and H. M. Smith, assistant chemist of the station, have resigned. S. H. Buel has been appointed assistant in farm experiments.

FLORIDA COLLEGE AND STATION.—Under a new organization of the college and station the members of the station staff, with the exception of the chemist, are to be professors of their respective subjects in the college. The director becomes professor of agriculture. The following changes have been made in the station staff: Horticulturist and pomologist, J. N. Whitner vice J. K. Fitzgerald; chemist, A. A. Persons vice J. M. Pickell, who has resigned to become professor of chemistry in Alabama State University.

GEORGIA STATION.—The experiment in cheese-making at the station with a view to promoting this industry in Georgia has thus far been very successful. A tobacco barn for curing by the Snow wire process is being erected at the station.

PURDUE UNIVERSITY, INDIANA.—In a special bulletin issued May, 1892, by H. A. Huston, tabulated analyses of 143 brands of commercial fertilizers offered for sale in Indiana are given. While there has been a considerable increase in the number of brands on the market during 1891, the estimated sales in that year were only 26,750 tons as compared with 29,000 in 1890.

OKLAHOMA STATION.—The board of regents as now constituted includes Governor A. J. Seay, Guthrie; R. J. Barker, Crescent; A. A. Ewing, Watonga; J. A. Wimberly, Kingfisher; J. P. Lane, Norman; T. Little, Chandler. Additions are to be made to the laboratory and barn. An ample water supply has been provided.

OREGON STATION.—With a view to the encouragement of dairying in the State a model dairy is to be established on the station farm.

VIRGINIA STATION.—R. H. Price, B. S., assistant horticulturist, has resigned to become professor of horticulture in the Texas College and horticulturist to the station.

WYOMING COLLEGE AND STATION.—E. E. Slosson, M. S., assistant chemist, has been made chemist to the station and professor of chemistry in the University of Wyoming. A building for the mechanical department will be erected at once, and will include shops for woodwork and ironwork, a foundry, engine room, drawing rooms, testing laboratories, etc.

BUREAU OF ANIMAL INDUSTRY.—The interest which has been shown by the stockmen of the United States in regard to the disease known as "lumpy jaw," or that form of actinomycosis which appears as external swellings on the head, renders it desirable that a preliminary statement should be made concerning the treatment of this disease. Until recently it has been the opinion of the veterinary profession that a cure could only be obtained by a surgical operation, and that this should be performed in the early stages of the disease in order to insure success.

In March last an important contribution to our knowledge of this subject was made by M. Nocard of the Alfort Veterinary School, in a communication to the French Central Society of Veterinary Medicine. He showed clearly that the actinomycosis of the tongue, a disease which appears to be quite common in Germany and is there known as "wooden tongue," could be quickly and permanently cured by the administration of iodide of potassium. M. Nocard calls attention to the success of M. Thomassen of Utrecht, who recommended this treatment as long ago as 1885 and who has since treated more than eighty cases, all of which have been cured. A French veterinarian, M. Godbille, has treated a number of cases with the same remedy, all of which have been cured. M. Nocard also gives details of a case which was cured by himself.

All of the cases referred to were of actinomycosis of the tongue, and no one appears to have attempted the cure of actinomycosis of the jaw until this was undertaken by Dr. Norgaard, veterinary inspector of the Bureau of Animal Industry. He selected a young steer in April last, in fair condition, which had a tumor on the jaw measuring 15½ inches in circumference, and from which a discharge had already been established. This animal was treated with iodide of potassium and the result was a complete cure, as stated in the reports which were recently given to the press at the time the animal was slaughtered in Chicago. If lumpy jaw can be cured so easily and cheaply, as this experiment would lead one to suppose, the treatment will prove of great value to the cattle-raisers of the country. As is well known, there is a considerable number of steers weekly coming to our markets which are condemned because they are diseased to such an extent that the general condition of the animal is affected. If these could be cheaply and readily cured by the owners it would prevent the loss of the carcass and solve all the troublesome questions which have been raised in regard to the condemnation of such animals.

The curability of the disease does not affect the principles which have been adopted in inspecting and condemning animals affected with it. This Department has never considered it necessary to condemn animals affected with actinomycosis on account of the contagiousness or the incurability of the disease. Such condemnations have been made when the disease was so far advanced as to affect the general condition of the animal, and all such carcasses would be condemned whether the disease from which the animal suffered was contagious or not or whether it was curable or incurable.

The treatment with iodide of potassium consists in giving full doses of this medicine once or twice a day until improvement is noticed, when the dose may be reduced or given less frequently. The size of the dose should depend somewhat upon the weight of the animal. M. Thomassen gives 1½ drams of iodide of potassium daily, in one dose, dissolved in a pint of water, until improvement is noticed, which he states is always within eight days. Then he decreases the dose to 1 dram. The animals do well under this treatment, showing only the ordinary symptoms which follow the use of iodide, the principal ones being discharge from the nose, weeping of the eyes, and peeling off of the outer layer of the skin. These symptoms need cause no uneasiness as they never result in any serious disturbance of the health.

M. Godbille has given as much as 4 drams (half an ounce) in one day to a steer, decreasing the dose half a dram each day until the dose was 1½ drams, which was maintained until the twelfth day of treatment, when the steer appeared entirely cured.

M. Nocard gave the first day 1½ drams in one dose to a cow; the second and succeeding days a dose of 1 dram in the morning and evening, in each case before feeding. This treatment was continued for ten days, when the animal was cured.

Dr. Norgaard gave 2½ drams dissolved in water once a day for three days. He then omitted the medicine for a day or two and continued it according to symptoms. These examples of the treatment, as it has been successfully administered by others, will serve as a sufficient indication for those who wish to test it.

Experiments are now being conducted on a large scale by the Bureau of Animal Industry in the treatment of lumpy jaw with this remedy, and the results will be published as soon as possible. In the meantime it would be well for all who have animals affected with this disease to treat them according to this method and report results to this Department.

THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.—The executive committee of the Association have issued a call for the sixth annual convention, to be held at New Orleans, Louisiana, commencing Tuesday, November 15, 1892. The headquarters of the Association will be at the St. Charles Hotel. The program for the sessions and other particulars are to be announced later.

NOVA SCOTIA.—The Annual Report of the Secretary for Agriculture for 1891 contains accounts of field experiments on the farm of the Provincial School of Agriculture. These included experiments with fertilizers on potatoes, grass, and barley; culture experiments with potatoes, oats, clover, and grass; feeding experiments with pigs and milch cows; and tests of varieties of potatoes, wheat, oats, and corn.

BERLIN UNIVERSITY.—Prof. Emil Fischer of Würzburg, well known for his extensive contributions to the chemistry of sugars, has accepted a call to the Berlin University as successor to Prof. A. W. v. Hofmann, who died May 5.

THE ASSOCIATION OF GERMAN NATURAL SCIENTISTS AND PHYSICIANS.—This Society will meet this year at Nuremberg, Bavaria, September 12–16. The speakers in the section on agricultural chemistry and agricultural experimentation thus far announced are, Prof. Liebscher of Göttingen, a contribution to the nitrogen question; Dr. G. Loges of the Posen Station, on sources of error in the determination of phosphoric acid by the molybdic method; and Prof. Maercker, subject not announced.

THE CHEMISTRY OF SOUTH AFRICAN WOODS, FOODS, AND LEGUMINOUS PLANTS.—*Chemical News* contains a notice of a pamphlet published by C. F. Juritz of the University of the Cape of Good Hope, on the Chemical Constituents of Some Colonial Food Plants and Woods. The author shows the influence of climate on the albuminoid constituents of plants, these being relatively more abundant in the warm than in the cold climates. Plants grown in the warm locality of Oudtshoorn were found to contain more albuminoids than those grown at Stellenbosch, and the latter in turn more than those grown in Europe. An important consideration in comparing South African plants with those of Europe is that the former always contain a smaller proportion of water, and consequently a relatively larger proportion of the valuable constituents. This is especially prominent in the case of products used for feeding stuffs. As regards tannin, none of the African woods and barks seem to equal those of Australia, though they excel those of Europe; the richest, the bark of "boukenhout," contains 15.96 per cent of tannin.

MANUAL OF BACTERIOLOGY.—*Chemical News* announces that a manual of bacteriology by Dr. A. B. Griffiths is soon to be published. It will be essentially a manual for the laboratory and will be useful to chemists, sanitarians, agriculturists, medical men, brewers, and others. It will be illustrated with 35 figures.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

JULY, 1892.

DIVISION OF STATISTICS:

Report No. 97 (new series), July, 1892.—Report on the Area of Corn, Potatoes, and Tobacco, and Condition of Growing Crops.

OFFICE OF FIBER INVESTIGATIONS:

Report No. 4.—A Report on Flax Culture for Fiber in the United States, Including Special Reports on Flax Culture in Ireland, Belgium, and Austria, with Statements Relative to the Industry in Russia.

WEATHER BUREAU:

Bulletin No. 2.—Notes on a New Method for the Discussion of Magnetic Observations.

Monthly Weather Review, April, 1892.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. III, No. 11.

Farmers' Bulletin No. 9.—Milk Fermentations and their Relations to Dairying.

Experiment Station Bulletin No. 12, June, 1892.—Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

JULY, 1892.

CANEBRAKE AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 15, July, 1892.—Cattle-Feeding.

ARKANSAS AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 19, May, 1892.—Manures and some Principles in Farm Manuring.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:
Appendix to the Annual Report for 1890.—Alkali Lands, Irrigation, and Drainage in their Mutual Relations.

THE DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 17, June, 1892.—Hand Power Cream Separators.

GEORGIA EXPERIMENT STATION:
Special Bulletin No. 17½, July, 1892.—The Air and the Soil in their Relations to Agriculture.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:
Bulletin No. 40, June, 1892.—The Silo and Silage in Indiana.

KANSAS AGRICULTURAL EXPERIMENT STATION:
Fourth Annual Report, 1891.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS:
Bulletin No. 17 (second series).—Results of 1891 Obtained at the State Station.

MAINE STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:
Annual Report, 1891, part IV.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 42, June, 1892.—Feeding Experiments with Milch Cows.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:
Meteorological Bulletin No. 42, June, 1892.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:
Bulletin No. 88, July 8, 1892.—Analyses of Home Mixtures and Incomplete Fertilizers.

AGRICULTURAL EXPERIMENT STATION OF NEW MEXICO:
Bulletin No. 7, June, 1892.—Scale Insects in New Mexico.

NEW YORK AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 42 (new series), May, 1892.—Analyses of Commercial Fertilizers.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 38, June, 1892.—The Cultivated Native Plums and Cherries.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 86*a*, May 30, 1892.—Meteorological Summary for North Carolina, April, 1892.

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 6, June, 1892.—The Mustard Family.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 16, May, 1892.—The New Fertilizer Law for Rhode Island; Selling Price of Fertilizer Stock; Analyses of Commercial Fertilizers, State Inspection, 1892; Miscellaneous Analyses.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 31, May, 1892.—Meteorology.

WYOMING AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 7, July, 1892.—Insecticides.

EXPERIMENT STATION RECORD.

VOL. IV. SEPTEMBER, 1892. NO. 2.

The study of bacteria, as connected not only with the science of medicine but also with that of agriculture, has made such rapid progress and such surprising results have already been attained that a tendency has naturally developed to spread the inquiries beyond their legitimate limit. The ease with which bacteria can be found, especially in the diseased tissues of animals and plants, has led many observers to conclude that their mere presence was sufficient to establish their causal relation to the disease. Even when further investigations seemed necessary to establish this presumption they have often been conducted without reference to the fundamental principles of bacteriology, as at present ascertained. In view of the need of caution in the management of bacteriological inquiries along the lines related to the work of our agricultural experiment stations, the following suggestions, furnished us by Dr. H. L. Russell, who has lately made special studies in bacteriology in Koch's laboratory in Berlin and at Johns Hopkins University, seem timely and helpful.

It is clearly apparent that the presence of microörganisms in the diseased tissues of plants, unsupported by further experimental proof, does not show that the disease in question is of bacterial origin. The probabilities are much stronger for the view that the microörganisms present are only saprophytic in their nature. They are present as organisms of decomposition, and as such often complete the dissolution of the tissue which has been set up first by other causes. Where microörganisms are found in large numbers on the border line between the sound and healthy tissue on the one hand and the diseased on the other, there is a possibility that they may have a causal relation to the diseased condition; but even here further proof must be forthcoming before the bacterial nature of the disease can be fully recognized.

Some observers have gone a step farther and have transferred bits of diseased tissue containing bacteria from affected to healthy plants. If the disease spread to any extent this has been regarded as sufficient evidence that the malady was of a bacterial nature; but even with this

proof there is no more than a probability to support the idea that the trouble is due to the action of microörganisms. All that is really proven by such a course of experimentation is the contagious nature of the malady. The cause of the contagion may or may not be bacterial. Where bits of tissue of any considerable size are used to infect healthy plants it is possible that a local death of the surrounding tissue may be caused by the transferred metabolic products of the organism causing the malady rather than to the action of the organism itself.

The proof necessary to establish the causal relation between a specific bacterium and a plant disease should be as conclusive and thorough in all respects as that required in animal pathology. The canons formulated by Koch, which must be satisfactorily answered before we can say positively that an animal disease is due to bacteria, are just as applicable in the realm of bacterial plant diseases.

The specific bacterium must be found in all cases of the disease; it must be found in this and no other disease; and it must be present in the tissues in such numbers that the pathological condition of the plant can be satisfactorily explained by the presence of the microörganism. To answer these three conditions in a satisfactory way it is necessary to subject the tissue to other tests besides a careful microscopic examination. The methods of staining, so useful in detecting bacteria in animal tissue, have not as yet been perfected in relation to vegetable tissue; so microscopical observation alone does not afford us a safe means of differentiating the bacteria from the tissue. It is necessary that we isolate the cause of the trouble from the diseased tissue itself by artificial methods of cultivation. Usually this is not particularly difficult, although a certain amount of experimentation must first be made before we can select the most favorable substratum for growth. By these methods of isolation we are able to separate all the various forms that happen to be in the diseased tissue. Associated with the specific germ of the disease (supposing it to be of a bacterial nature) are usually other forms that play only a secondary rôle. The prevalence of a certain form will usually indicate which is the cause of the malady, but this alone is insufficient. It will depend largely upon the original position of the bit of tissue from which the cultures are made. If removed from the older portions of the diseased tissue, saprophytic organisms will no doubt predominate. If bits of tissue are taken from the border line between the healthy and diseased parts, the specific cause of the disease will more likely be found. But one link of the chain of evidence, and the most important, is still wanting. Having isolated the various forms from the diseased tissue, it is necessary to carry out a series of inoculation experiments upon the healthy living host. The conditions of the experiment should conform as closely as possible to the conditions under which the host suffers most severely, as regards age of plant, atmospheric conditions, etc. Only when we have been able to produce a diseased condition of

our host plant that is similar to the disease in a state of nature can we regard our chain of evidence as to the cause of the disease complete.

Subjected to the above rules we would find our list of so-called bacterial plant diseases much diminished. But we must follow rigid methods if we are to make any real advance in this field of inquiry.

The conditions under which bacteriological work has to be carried on as well as the state of the science, offer great encouragement to our stations to undertake inquiries in these lines. It is a mistake to suppose that in order to do bacteriological work it is necessary to have an elaborate equipment of expensive thermostats, sterilizers, and other apparatus. The equipment for certain lines of experimental work in pathological inquiry from a medical standpoint calls for more accurately adjusted conditions than is necessary for the study of many problems from an agricultural standpoint. Good work has and can yet be done with but little other than the simplest appliances, and it may be safely asserted that the expenses of an equipment for excellent work along these lines is much less than for many other grades of experimental work.

The different parts of this new field have as yet been touched only here and there, and much work of a general nature needs to be done before many special problems can be intelligently taken up.

To do this the general principles of the subject in relation to agriculture need to be more thoroughly developed, and there is no good reason why this work can not be carried out by our stations as a part of their purely scientific work.

Medicine has taken up the subject largely from the hygienic standpoint and outside of pathogenic forms little has been done on the general biology of microörganisms since the death of De Bary. The whole domain of the physiology of bacteria offers numerous problems of which we know as yet but little. This work of general biological inquiry may not offer directly any practical results, but it is necessary that our knowledge of the general laws which govern bacterial life should be increased before we can intelligently take up certain special problems.

Besides the general studies on the biology of bacteria, there are many special problems which invite investigation. The good already secured from the researches on the bacterial diseases of plants—researches which had their origin in this country—encourages the hope that with the advance of knowledge of general principles and the discovery and adoption of better methods results of even wider practical application will be attained.

The history of the researches on the bacteria of milk is instructively presented by Dr. Conn in Experiment Station Bulletin No. 9, an abstract of which may be found on page 201. The practical results already

attained are of great importance to the dairy industry, but a careful perusal of the bulletin will show numerous problems inviting the attention of the investigator. The chief value of such a résumé is, after all, in stimulating further inquiries. It is hoped that in this, as in other lines of work relating to dairying, our stations will be able to make discoveries of permanent value. Evidently the way to the improvement of the methods and processes of the dairy is along the line of scientific researches which deal with the forces which escape ordinary observation. Experimental work in dairying which does not take into account the ascertained facts concerning the bacteria of milk and its products invites failure from the start.

The appropriation bill for the United States Department of Agriculture for the fiscal year ending June 30, 1893, carries the following general items: For the Office of the Secretary of Agriculture, $80,500; for the extension of foreign markets for agricultural products, $10,000; for rain-making experiments, $10,000; for the collection of information regarding methods of irrigation, $6,000; Division of Accounts and Disbursements, $19,100; Division of Statistics, $136,100, of which $15,000 is for maps and charts illustrating the progress of rural production and crop distribution, and for special investigations of the agricultural statistics of the Rocky Mountain region; Division of Botany, $36,100; Division of Entomology, $27,300, of which $2,500 is for an investigation of the cotton bollworm; Division of Economic Ornithology and Mammalogy, $24,860; Division of Pomology, $11,300; Division of Microscopy, $6,700; Division of Vegetable Pathology, $25,600; Division of Chemistry, $36,500, of which $12,500 is for the continuance of investigations of the adulteration of foods, drugs, and liquors; $20,000 is also appropriated for experiments in the culture of sugar beets, cane, and sorghum, and the manufacture of sugar; Division of Forestry, $19,820; Division of Records and Editing, $6,300; Division of Illustrations, $19,000; Division of Seeds, $148,920; document and folding room, $10,460; experimental grounds and garden, $31,000; museum, $7,840; fiber investigations, $5,000; library, $3,000; furniture, repairs, postage, and contingent expenses, $40,000; Bureau of Animal Industry, $865,000, including $15,000 for quarantine stations; agricultural experiment stations, $728,000, including $20,000 for the Office of Experiment Stations; Weather Bureau, $898,595.50; total, $3,232,995.50.

In this appropriation bill authority is given to the Secretary of Agriculture to sell copies of the card index of agricultural literature prepared by this Office, at a price "covering the additional expense involved in the preparation of these copies."

CONVENTION OF ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS, 1892.

The ninth annual convention of the Association of Official Agricultural Chemists was held in the lecture room of the National Museum at Washington, August 25, 26, and 27. Fifty-five chemists were present.

The president, Prof. N. T. Lupton, in his opening address, urged strict conformity to the official methods as laid down at each convention of the Association, maintaining that the discrepancies observed in analytical results could in many cases be explained by departures by individual chemists from the prescribed methods of analysis. These methods, especially those for the determination of potash, have not escaped criticism, but, as the work of the Association and of individual chemists shows, they have given good results, and changes in them should be made only after careful consideration and thorough investigation. The need of judicious and uniform legislation, particularly as regards fertilizer inspection in the different States where at present conflicting and in many cases ineffective laws are in force, was pointed out and emphasized. A brief review of the more important scientific investigations of the year was also given. Of these, the study of the fixation of free nitrogen by plants and soils and the formation of nitrates from atmospheric nitrogen by electrical discharges were especially referred to as pointing toward the practical utilization of a vast store of the most expensive element of plant food hitherto considered unavailable. The development of the phosphate beds of the South was also discussed as a question of great interest to the agricultural chemist.

Dairy products.—The report on this subject was submitted by S. M. Babcock. As instructed by the last convention, the reporter planned and had carried out a series of comparative tests of the Leffman and Beam soda-glycerine and the ordinary Reichert methods for determining the volatile acids in butter. It appeared from this report, as well as from the discussion which followed, that while the Leffman and Beam method with careful manipulation would give results closely concordant with those obtained by the ordinary method (except in case of rancid butter with which the results were low), yet in view of the fact that slight variations in manipulation, as for instance, in time of saponification, might cause considerable variation in results, it was deemed advisable for the present to recommend it simply as a preliminary test and to wait for further investigations to determine its true

value. The work of the past year showed with considerable unanimity that the results obtained by distilling volatile acids through block-tin condensers were not always reliable, unless unusual precautions were taken to cleanse the apparatus before use. This appeared to be due to the reaction of the products of distillation on the tin. It was therefore recommended, and the recommendation was adopted, that only glass condensers be used in the distillation of volatile acids. With the exception of these changes the methods remain the same as those adopted at the last convention.

In cheese analysis the reporter called attention to the difficulty of obtaining uniform samples. His recommendations regarding sampling and methods of analysis, which were adopted as provisional methods for the coming year, were as follows:

Sampling.—Where possible a narrow segment of the cheese is taken, chopped quite fine, with care to avoid evaporation of water, and the several portions for analysis taken from the mixed mass. In other cases a plug may be taken with a cheese tester perpendicular to the surface at one third of the distance from the edge to the center of the cheese, reaching entirely or halfway through the cheese. It is advisable to take plugs in this manner from different portions of the cheese, split them lengthwise, and mix. For inspection purposes the rind may be rejected.

Moisture.—Dry 5 to 10 grams in thin slices in a platinum or porcelain dish containing a little freshly ignited asbestos at 100° C. for ten hours, or in the same manner over sulphuric acid to constant weight.

Ash.—Burn the dry residue thus obtained in a muffle furnace at a low red heat.

Fat.—Grind 5 to 10 grams of the sample with about twice its weight of anhydrous copper sulphate and extract with anhydrous ether for fifteen hours.

Casein.—Determine nitrogen in 2 grams of the substance by the Kjeldahl method and multiply the result by 6.25 for casein.

The reporter on methods of analysis of cheese for the coming year was instructed to make comparative tests of drying the cheese and the ether extract in air and in hydrogen gas.

FERTILIZERS.—*Phosphoric acid.*—The reporter on phosphoric acid, N. W. Lord, called attention to the errors which may be due to improper preparation and handling of samples and also to the inefficiency of the present method of determining moisture. He recommended instead of the direction to dry for five hours at 100° C. in a steam bath, to dry for five hours in a copper oven three fourths full of water which is kept boiling continuously. This change, which was the only one recommended by the reporter on phosphoric acid, was adopted by the convention.

A paper on The occurrence of metaphosphoric acid and pyrophosphoric acid in cotton-seed meal was presented by M. B. Hardin. The results of the author's studies lead him to believe that the failure to secure all of the soluble phosphoric acid by direct treatment with

molybdic solution is due not so much to the presence of organic matter as to the fact that but a small proportion of the phosphoric acid occurs in the form of tribasic salt. Whether metaphosphoric acid or pyrophosphoric acid exist in cotton-seed meal or are formed during the preparation of the meal is a point believed by the author to be worth investigating.

A paper on The use of ammonium nitrate in the determination of phosphoric acid, by H. J. Wheeler and B. L. Hartwell, was read by H. J. Wheeler. Comparative determinations with and without ammonium nitrate gave practically identical results.

H. A. Huston reported results of heating phosphates sent out by the reporter in 1892, at 100° to 107° C. for periods of five to eight hours either in air or in hydrogen gas.

Potash.—The most important change recommended by the reporter on potash, G. F. Payne, and adopted by the convention, was the discontinuance of the use of sodium chloride in the Lindo-Gladding method. It was decided further not to specify the quantity of platinic chloride to be used, but to leave this to the discretion of the analyst. The recommendation is therefore to add a slight excess. A communication from the New Jersey Station on the comparative determination of potash with and without sodium chloride, was presented by E. B. Voorhees.

Nitrogen.—The report on nitrogen was submitted by L. L. Van Slyke. The alterations in the methods adopted by the convention were as follows: (1) The omission of the potassium tetraoxalate and ammonium chloride methods from the official directions for the standardizing of acid and alkali solutions, leaving the silver nitrate method as the only available one for this purpose; (2) the adoption of the Gunning method as an alternate for materials free from nitrates.

The results of comparative determinations of nitrogen by the Ruffle, absolute, soda-lime, and Kjeldahl methods, by T. C. Trescott, were presented by H. W. Wiley. Papers on Potassium tetraoxalates, comparison of different makes, keeping qualities, hydroscopicity, recrystalization, etc., and Standardization of acid and alkaline solutions were read by C. L. Parsons. R. De Roode reported results of determinations of phosphoric acid and nitrogen in the same weighed sample with and without the use of permanganate. Papers on the Gunning-Kjeldahl method, and a modification applicable in the presence of nitrates, by E. B. Voorhees, and on The Ulsch method in determining nitric nitrogen in compound fertilizers, by J. P. Street, were then presented. M. A. Scovell read a paper on Tests of the modified Gunning method on pure nitrates. The method gave practically theoretical percentages of nitrogen.

The reporter on nitrogen for the coming year was instructed to make investigations looking to the application of the Gunning method in the presence of nitrates and to test the method of using one fourth normal sulphuric acid in preparing standard solutions.

SOILS AND ASH.—H. H. Harrington presented a report on this subject, which was discussed at some length. Numerous alterations and emendations of the methods were adopted; among others the suggestion of E. W. Hilgard, in *Agricultural Science*, 1892, p. 329, regarding the advisability of taking soil samples to a depth indicated as proper by the character of the soil itself, and not to a uniform depth of 9 inches in each case. The use of one half mm. sieves for separating the fine earth for analysis is to be made a subject of study next year.

Prof. M. Whitney exhibited special apparatus for soil examination, and described methods used by him for sampling and analyzing soils.

FEEDING STUFFS.—Two reports were submitted on this subject, one by W. H. Jordan, the other by J. T. Anderson. The subjects investigated by the first reporter were the Patterson method of purifying ether extracts; methods of ash determination; Hönig's method of crude fiber determination; and comparative tests of drying in hydrogen and air. Few changes were recommended in either report. The time of drying samples in the determination of moisture was extended to 5 hours. A provisional classification of feeding stuffs into those rich in fiber and poor in fiber was adopted for the ensuing year. The reporter was instructed to investigate the advisability of drying the material before extraction with ether and of using alcohol-free ether.

SUGARS.—A lengthy report, with a review of literature, was presented on this subject by B. B. Ross. Numerous changes in the official methods were recommended and adopted. The methods, as finally amended, were made provisional for the coming year.

FERMENTED LIQUORS.—C. A. Crampton reported the work of the year on fermented liquors. Various changes in methods (the most important being the substitution of weighed for measured portions of liquor) were suggested and adopted. The emended methods were made provisional instead of official for the coming year.

On invitation of the Association, Assistant Secretary Willits of the U. S. Department of Agriculture, delivered a short address.

Officers for the ensuing year were chosen as follows: President S. M. Babcock, vice president E. B. Voorhees, secretary H. W. Wiley, executive committee B. W. Kilgore and E. H. Farrington.

Reporters on methods of analysis and committees appointed by the president are as follows: Reporter on phosphoric acid R. De Roode, potash N. Robinson, nitrogen C. L. Parsons, soils and ash E. W. Hilgard, dairy products A. L. Winton, foods and feeding stuffs low in fiber F. W. Woll, foods and feeding stuffs high in fiber G. L. Teller, fermented liquors C. A. Crampton, and sugar G. L. Spencer; committee on World's Fair Auxiliary Congress, S. M. Babcock, H. W. Wiley, M. A. Scovell, H. A. Huston, and L. A. Voorhees; committee on abstracts W. Frear, A. L. Winton, E. W. Allen, B. B. Ross, and F. W. Woll.

The place of next meeting is to be determined by the executive committee.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

METEOROLOGY.

Meteorological observations at Maine Station, M. C. FERNALD (*Maine Sta. Report for 1891, pp. 155–158, 165–174*).—Observations with hygrometers, soil thermometers, terrestrial and solar radiation thermometers, and on the amount of sunshine, velocity of the wind, and rainfall are summarized for each month from April to October 1889–'91, inclusive, together with a daily record of the observations for September, 1891.

Observations with hygrometers.

It appears from observations covering the period of growth of three years that the excess of moisture in forest above that of open field in the morning amounts to but 5 per cent, while in the middle of the day it rises to 15 per cent, and at nightfall drops down to 10 per cent, and that the mean excess for the day is 10 per cent. In a very dense forest the percentage of excess would undoubtedly rise much higher. The presence of patches of forest in any region exerts a marked influence on the hygroscopic condition of the atmosphere, and this condition in turn is an important factor in the growth of vegetation.

The average excess of solar intensity above that given by the maximum thermometer was 58.36°. During the seasons of 1890 and 1891 the average number of hours of bright sunshine per day was 6.3. The average velocity of the wind in 1889 was 8.02 miles per hour; in 1890, 8.34; in 1891, 7.79. The total rainfall in 1889 was 18.85 inches; in 1890, 32.52 inches; in 1891, 23.07 inches.

Meteorological summary for June, C. D. WARNER (*Massachusetts Hatch Sta. Meteorological Bul. No. 42, June, 1892, pp. 4*).—A daily and monthly summary of observations for June at the meteorological observatory of the station.

Meteorological summary for North Carolina, April, 1892, H. B. BATTLE and C. F. VON HERRMANN (*North Carolina Sta. Bul. No. 86a, May 30, 1892, pp. 16*).—Notes on the weather, monthly summary, and tabulated records of meteorological observations by the North Carolina weather service coöperating with the United States Weather Bureau. The bulletin is illustrated with maps showing the isothermal lines and the total precipitation at the stations in different parts of the State.

SOILS.

W. H. BEAL, *Editor.*

Alkali lands, irrigation, and drainage in their mutual relations, E. W. HILGARD (*California Sta. Report for 1890, Appendix, pp. 69*).—This is a "revised reprint [the first edition being issued in 1886] from the reports of the College of Agriculture and experiment station and from the report of the Tenth United States Census, with an abstract of the Government report on the alkali lands of India," with such changes and additions as the progress of the inquiry warrants. The whole has been rearranged in systematic order for convenience of reference. The subjects treated are, the source and composition of alkali and its effect on soils and plants; reclamation of alkali lands; composition of lake, river, and artesian waters of California, and their quality for irrigation; and irrigation and alkali in India.

The publications containing matter included in this report which have been abstracted by this Office are Bulletins Nos. 82 and 83, and the Annual Report of the station for 1890 (E. S. R., vol. I, pp. 10, 189, and III, p. 590).

The suggestion made [by the author] twelve years ago, that gypsum would prove an efficacious neutralizer of "black alkali," has led to such satisfactory results and has given rise to so lively a search for a supply of that material that it can now be obtained almost anywhere in the State at rates which the farmer can afford. * * *

In districts afflicted with carbonate of soda in the soil it has been found in numerous cases that the simple use of gypsum conjointly with summer tillage to keep the soil loose, has sufficed to enable land that never before produced anything of value to bear abundant crops. But the failure to secure a similar result in the neighboring fields, at times, has caused unnecessary discussions as to the utility of gypsum. It should be remembered that where the amount of soluble salts present in the soil is very large, gypsum may mitigate but can not altogether relieve the trouble; its action must be supplemented by other means calculated to remove the soluble salts from the soil. In case carbonate of soda should not be present gypsum will effect no improvements at all. * * *

It is of the utmost importance that the "black" part of the alkali—the salsoda—be gotten rid of in every case, and this can be done by giving the soil a dressing of gypsum. It keeps the humus from being dissolved and washed away, and above all it converts the "black" alkali into "white;" that is, the carbonate of soda will have been turned into sulphate of soda or Glauber's salt, which is one of the chief ingredients of all alkali, and is quite bland and harmless as compared with the corrosive salsoda. * * * In thousands of cases this change, with thorough tillage, is all that is needful to do away with all damage from alkali. * * *

There is one virtue possessed by gypsum that has not yet been alluded to: It is that when (as is frequently the case) the alkali contains alkaline phosphates in solution these phosphates are fixed and retained in the soil, whereas otherwise every rain and every irrigation washes them out more or less. The same advantage is secured as already stated in respect to the humus dissolved by the carbonate of soda.

Some effects produced by rolling spring-plowed land, F. H. KING (*Wisconsin Sta. Report for 1891, pp. 91–99*).

Synopsis.—Approximately 1 acre of a clay loam soil underlaid at a depth of about 4 feet with a nearly pure sand, was plowed and harrowed April 28, and divided into two equal parts, on one of which oats were drilled and on the other barley. At the same time two thirds of each plat was rolled with a 1,410-pound iron roller and one half of each rolled strip was then lightly harrowed. The results were as follows: (1) The germination of both oats and barley was decreased and that of oats retarded; (2) the yield of oats (grain) was practically the same under the three treatments, but the yield of straw and dry matter was greater on the rolled strips; (3) examinations of the soil at time of seeding and after harvest indicated little difference in the water content of the different strips.

This is a continuation of work begun in 1889, which has been reported in the Annual Reports of the station for 1889, p. 189, and 1890, p. 120 (E. S. R., vol. II, pp. 432 and 442), and includes observations on the influence of rolling (1) on germination of oats and barley, (2) on the yield of oats and barley, and (3) on the water content of the soil.

Influence of rolling on the germination of oats and barley (pp. 92–94).—The results of examinations of the oats and barley ten and fourteen days after seeding (in drills) are given in tables.

From the facts [presented] we may safely conclude that rolling both oats and barley after seeding with the drill had the effect of decreasing the amount of germination and of retarding it with the oats. * * *

The data are insufficient to justify a positive assertion as to just why the rolling diminished the germination, but I believe it is due largely to insufficient aëration of the soil. The fact that there was decidedly better germination on the rolled ground which was harrowed seems to indicate that the difference was not due to too deep covering directly.

Influence of rolling on the yield of oats and barley (pp. 94–97).—The yield of oats and straw per acre and the per cent of dry matter are tabulated for the rolled and unrolled plats. The average results were as follows:

	Unrolled.	Rolled.	Rolled and harrowed.
Grain, bushels per acre	73.2	74.3	73.76
Straw, pounds per acre	3,645	3,734	4,011
Dry matter, per cent	43.72	46.20	46.47

This table shows very clearly that the yield of oats per acre is practically the same on the soil having the three kinds of treatment. It is not so, however, with the yield of straw per acre, neither is it with the per cent of dry matter, for in both of these cases, the oats were not only nearer ripe on the two rolled strips, but the weight of dry matter in the straw was also greater.

An accident impaired the results with barley, but it appeared that rolling alone tended to retard growth and diminished the yield of dry matter, while harrowing after rolling produced a larger yield per acre than was produced on the unrolled plats.

Water content of rolled and unrolled soils (pp. 98, 99).—Samples of the soil taken at the time of seeding showed very little difference in the

water content of the different plats. After harvesting the grain samples were again taken at depths of 1 to 4 feet and the moisture determined. The averages for the 4 feet were as follows:

	Water in oat ground.	Water in barley ground.
	Per cent.	*Per cent.*
Rolled and harrowed	11.89	14.52
Rolled	11.20	14.30
Unrolled	12.53	14.75

The table shows that while the drilled and rolled ground in both cases contained less water at the end of the growing season than the simply drilled ground did, yet the difference is too small to suggest that the influence of rolling upon the rate of evaporation from the soil persists throughout the growing season. * * * The larger per cent of water left in the barley ground is due partly to the earlier cutting of that grain, partly to the smaller amount of dry matter produced per acre, and partly to the fact that less water is required for a pound of dry matter.

Investigations relating to soil moisture, F. H. KING (*Wisconsin Sta. Report for 1891, pp. 100–134, figs. 2*).

Synopsis.—The following subjects are treated: (1) Influence of spring plowing in checking the evaporation of soil water; (2) early tillage to prevent formation of clods; (3) rise of water in natural field soil from below a depth of 5 feet; (4) influence of surface tillage upon the rate of evaporation; (5) influence of farmyard manure on the movement and amount of water in the soil; (6) manured and unmanured corn ground; (7) influence of fallowing ground on the water content of the soil; (8) the amount of water required to produce a pound of barley, oats, and corn in Wisconsin; and (9) the vertical extent of root-feeding.

Accounts of similar work are given in the Annual Reports of the station for 1889 and 1890 (E. S. R., vol. II, pp. 432 and 442).

Influence of spring plowing in checking the evaporation of soil water (pp. 100–103).—On April 28 a piece of land which had previously been in corn was plowed and seeded to oats. On April 29 and May 6 samples of soil were taken in foot sections down to a depth of 4 feet. Determinations of the water content in these samples showed little change between these dates. The water content in parallel plats of unplowed soil was also determined May 6. The tabulated results show "that the unplowed land contained in the upper 4 feet 9.13 pounds less water than the unplowed ground on May 6, an equivalent of 1.75 inches of rainfall." Soils from three other localities on plowed (in two cases fall-plowed) and unplowed land were also examined. "These three cases also [show] that more water has been evaporated from the unplowed than from the plowed ground, and this too when two of the cases cited were fall plowing. The surface foot in each of these cases is decidedly dryer on the unplowed ground, the difference amounting to 2.7 pounds per square foot."

Early tillage to prevent the formation of clods (p. 103).—Of 2 parallel plats, 1 plowed April 28 was left in excellent tilth, while the other, left eight days longer, became exceedingly cloddy and required

repeated harrowing and rolling to bring it into a condition of tilth approximating that of the other plat.

"Not only did the delay in plowing increase fourfold the labor of fitting the ground, but it at the same time resulted in an unnecessary waste of water, which was really large and greatly needed."

Rise of water in natural field soil from below a depth of 5 feet (pp. 104, 105).

On May 14 a piece of fallow ground 7 feet square, kept entirely free from weeds, was covered so as to exclude all rain and sunshine from it, but so as to permit a free circulation of air over the surface. The water content of the soil was determined at the same time to a depth of 5 feet, which, when expressed in pounds per cubic foot, was as given below:

Water per cubic foot.

	Pounds.
First foot	7.99
Second foot	7.30
Third foot	14.86
Fourth foot	13.47
Fifth foot	8.82

On July 17 and September 30 samples of soil were again taken to a depth of 7 feet and the amount of water per cubic foot is given below:

Amount of water per cubic foot of soil.

Date.	First foot.	Second foot.	Third foot.	Fourth foot.	Fifth foot.	Sixth foot.	Seventh foot.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
July 17	9.03	14.63	14 37	13.26	8.52	9.87	19.79
September 30	6.05	14.50	11.90	11.86	6.30	3.51	15.55
Loss	2.98	0.13	2.47	1.40	2.22	6.36	4.24

In another locality, where samples were taken July 25 and again October 2, but which was wholly unsheltered and fallow, the results were as here given:

Date.	First foot.	Second foot.	Third foot.	Fourth foot.	Fifth foot	Sixth foot.	Seventh foot.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds*	*Pounds.*	*Pounds.*
July 25	10.44	16.91	14.81	10.38	7.82	13.66	22.29
October 2	9.49	16 27	14.41	6.99	7.74	7.85	19.35
Loss	0.95	0.64	0.40	3.39	0.08	5.81	2.94

It will be seen from these results that in both cases the sixth and seventh foot had lost quite large amounts of water. Standing water in the ground occurred at about 7.6 feet below the surface when the first set of samples were taken and at about 8.4 feet when the last samples were taken, in both localities. Unless it shall be shown by future study that these soils became dryer by a downward movement of the capillary water or by internal evaporation, what evidence we have goes to show that subsoils 6 and 7 feet below the surface may contribute large amounts of water, with the minerals they hold in solution, for the use of vegetation at the surface. It should be observed, in connection with the last locality cited, that a rainfall of 10.84 pounds per square foot had occurred without percolation, as ordinarily understood, during the interval in question, which probably accounts for the apparent smaller evaporation. In both localities the surface soil was a sandy clay loam running into a nearly pure sand at 4 feet below the surface.

Influence of surface tillage upon the rate of evaporation (pp. 105–111).—For studying this question five strips of land, 12 by 130 feet, were plowed and harrowed in the spring. Alternate plats were rolled May 14 and not disturbed afterwards, except to remove the weeds. "The other strips were cultivated frequently, to a depth of about 3 inches, until July 13. All the strips were fallow, and the soil was a sandy clay loam, underlaid at 4 feet with a rather coarse and nearly pure sand. Standing water occurred in the ground at a depth varying from about 6.5 feet to 7 feet below the surface on May 29, and had fallen not far from 0.5 of a foot on July 17."

Examinations of samples of soil taken at depths of from 1 to 6 feet on two of the inside plats showed the following losses of water:

Date.	From cultivated ground.	From uncultivated ground.
	Pounds.	*Pounds.*
May 29 to June 9	—9.49	—12.25
June 9 to June 17	—0 74	+0.06
June 17 to June 20	—2.31	—2.57
June 20 to July 17	—20.03	—24.83
Total losses	32 57	39.59

It is thus shown that during forty-nine days the uncultivated ground dried 7.02 pounds more than the cultivated ground. * * * If we assume that at first the water content in the two cases was equal, and this may be done without violence, for theoretically the cultivated ground should have been drier because it is farther from the water table, we find that during sixty-four days for each column of soil 1 square foot in section and 6 feet long, the uncultivated ground had dried 8.84 pounds more than the cultivated.

Computing from the observed losses the mean daily rate of evaporation per square foot from the surfaces in the two conditions, we get for cultivated ground 665 pounds per square foot and for uncultivated ground 808 pounds per square foot, and this is the amount of water over and above that which may have been brought into the upper 6 feet of soil from below by capillary action.

Influence of farmyard manure on the movement and amount of water in the soil (pp. 111–116).—The results are tabulated for observations of the water content at depths of from 1 to 6 feet on 4 plats, 2 of which received a heavy dressing of coarse horse manure, one green cow manure, and two remained unmanured. From the results obtained July 22 on the unmanured plat and that receiving horse manure, it appears "that while the aggregate amount of water in the plats which are manured and unmanured is practically the same, the distribution of it in the ground is markedly different in the two cases; for while the upper 3 feet of the manured ground contain an average of 1.09 pounds more water per cubic foot, the lower 3 feet contain 1.26 pounds less than the unmanured ground."

Examinations made July 27 on the unmanured plat and that receiving cow manure showed "that in every case except one, and that the sixth foot, the unmanured ground is dryer than the manured."

On this date we find not simply a difference in the distribution of water in the upper 6 feet, but a difference in the total quantity as well, the mean difference in the total amount of water being 4.5 pounds per each column 6 feet long and 1 foot square. It will be observed, however, that while the lower 3 feet of the unmanured ground are dryer than those of the manured, contrary to what was observed before, still the difference is decidedly less than between the upper 3 feet, the difference in the two cases being, upper 3 feet 2.91 pounds, lower 3 feet 1.57 pounds.

Manured and unmanured corn ground (pp. 117-120).—Samples of soil extending to the water table were taken on 2 manured plats and on an intermediate unmanured plat immediately after corn had been harvested, September 19. The absolute difference in the amount of water in a column of the soil 1 foot square under the two conditions was as follows:

	Unmanured.		Manured.		Difference.
	Dry soil.	Water.	Dry soil.	Water.	
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Surface to 2 feet	146.59	19.1	146.59	18.16	0.94
2 feet to 4 feet	185.85	33.6	185.85	31.65	1.95
4 feet to 5 feet	106.00	18.7	106.00	17.74	0.96
Sums		71.4		67.55	3.85

The table shows that the unmanured soil contained 3.85 pounds more of water than the manured soil, but it appears from other tabulated data given that the amount of water required for the increased yield of corn on the manured soil as computed from the difference in the amount of dry matter produced (301.49 pounds of water per pound of dry matter) corresponds to 7.92 pounds of water per column of soil 1 foot square and 5 feet deep, leaving a difference of 4.07 pounds which is not accounted for.

Now, if the excess of water demanded by the manured ground was obtained through a diminished surface evaporation simply, then the observed differences on the fallow plats at the close of the growing season should be found approximately equal to the amount demanded. The observed amount was 4.5 pounds per square foot, while the amount demanded was 7.92 pounds, a quantity nearly twice as great, and too large to be attributed to errors of observation. Unless, therefore, it is true that water is used by corn with much greater efficiency on manured ground, it follows that the manure has effected the drawing of water from greater depths by the corn, and if this was not done by forcing the roots to penetrate the soil more deeply, the rise of water must have been a third case of translocation.

While, therefore, the case stands confessedly as one lacking complete demonstration, the evidence in favor of the view that farmyard manure increases the capillary flow of water toward the surface, and thus supplies to crops both water and minerals held in solution by it which would otherwise be unavailable, is both cumulative and thus far positive.

Influence of fallowing ground on the water content (pp. 121-123).—Of the 3 plats used in this experiment, 2 had produced a crop of corn in 1890 while the third had remained fallow. In 1891 one half of each plat was seeded to oats and the other half to barley. In the spring of 1891 and at the time of harvesting the oats and barley, thirty-six

samples of soil were taken to depths of 4 feet and their water content determined, with the following results:

Table showing mean dry weight of soil per cubic foot and of water per cubic foot in fallow and not fallow ground in spring and at harvest.

Depth of sample.	Mean dry weight of soil per cubic foot.	In spring.				At harvest.			
		Plats 1 and 3, fallow.		Plat 2, not fallow.		Oats.		Barley.	
						Fallow.	Not fallow.	Fallow.	Not fallow.
	Lbs.	*Per ct.*	*Lbs.*	*Per ct.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1 foot	77.25	19.43	15.01	16.61	12.83	6.01	3.74	9.06	7.08
2 feet	79.79	20.55	16.40	17.76	14.17	9.65	4.45	11.90	10.10
3 feet	94.13	18.56	17.47	16.09	15.15	9.54	9.30	12.48	10.60
4 feet	98.07	17.78	17.44	15.11	14.82	8.93	8.43	14.07	11.52
Sums	....	....	66.32	....	56.97	34.13	25.92	47.51	39.30

It will be seen from this table that the difference in the amount of water in the soil at harvest is only 1.14 pounds less than it was in the spring, and yet the amount of dry matter produced on the fallow ground was greater than that produced on the not fallow ground, so that other things being equal the fallow ground ought to have been found the dryer at harvest by the difference in the amount of water required by the crops in the two cases. If the consumption of water was proportional to the amount of dry matter produced and at the observed rate, the oat ground which had been fallow should have dried 3.09 pounds more than that not fallow, but it did dry only 1.14 pounds more, and this shows an advantage of 1.95 pounds of water for each column of soil 1 square foot in section and 4 feet long in favor of the fallow ground. In the case of the barley the fallow ground should have dried 13.08 pounds more than that not fallow, but like the oat ground it did dry only 1.14 pounds more, so that there is an apparent advantage of 11.94 pounds of water per square foot extending to a depth of 4 feet.

Examinations of the soil before the experiment began show that while there is a slight natural tendency of plat 2 to be dryer than plats 1 and 3 the difference is not sufficient to account for that observed as an effect of fallowing.

The amount of water required to produce a pound of barley, oats, or corn in Wisconsin (pp. 124–131).—This included (1) observations on plants growing in barrels, and (2) on plants growing under natural conditions in the field.

[In the first case] the aim has been to make the conditions as nearly as possible those which exist in actual field culture, and to do this the barley, oats, and corn were grown in 50-gallon barrels standing with their tops flush with the top of the ground, in pits sunk in fields of the respective grains. The barrels were filled with soil taken from the place and in each case the experiment was in duplicate. In all cases the barrels received the natural rainfall and in addition watering was resorted to from time to time as the cases required, an effort being made to maintain the barrels at nearly constant weights. No effort was made to check surface evaporation from the soil, but the barrels being painted and standing in the ground the loss of water through the side was certainly not large. With the oats and barley the surface soil was not disturbed after the seeding, but in case of the corn the ground was frequently stirred to correspond with the field cultivation.

[A summary of the observations is given in the following table:]

Table showing the amount of water required for a pound of dry matter in oats, barley, or corn in Wisconsin.

		Water used.	Dry matter produced.	Water per pound of dry matter.		Computed yield per acre.	Computed amount of water.	
							In tons per acre.	In inches.
		Pounds.	*Pounds.*	*Pounds.*	*Mean.*	*Pounds.*		
Barley	1	158.30	0.3966	399.14	401.74	....	....	....
Barley	2	141.03	0.3488	404.33		7,441	1,494.67	13 19
Oats	1	224.25	0.4405	509.31	501.47	....	....	....
Oats	2	220.70	0.4471	493.63		8,861	2,221 76	19.60
Corn	1	300.45	1.0152	295.95	301.49	....	....	....
Corn	2	298.65	0.9727	307.03		19,845	3,991.53	26.39

In the cases of barley and oats, so far as could be observed the stand of grain on the ground in the barrels and the growth of it throughout the season were perfectly normal, but the yield of dry matter per acre in the field in which the barrels stood was 6,083 pounds of oats and 4,157 pounds of barley per acre as the average deduced from plats 1, 2, and 3, between which the barrels stood and with the soil of which they were filled, while the yield from the barrels was at the rate of 8,861 pounds of oats and 7,441 pounds of barley per acre, as given in the table.

In the case of the corn the conditions and the growth as well were quite different in the barrels from what they were in the field in which they stood. Each barrel matured four stalks of corn on an area of 2.1817 square feet, but in the field there were four stalks to each 9¼ square feet, which is more than four times the area. This being true, the amount of evaporation from the ground itself as compared with that which took place through the growing corn must have been relatively larger in the field than in the barrels, and this must tend to make the amount of water required for a pound of dry matter, as indicated by the experiment, too low for the conditions in the field.

Although the growth of the corn was checked by a deficiency of water in the lower soil of the barrel, the actual yield of dry matter per acre was 19,845 pounds, while that of the surrounding field was 8,190.5 pounds.

[In field observations made] in 1890 and again in 1891 the water content of soil upon which corn was grown was determined at the time of planting and again when the corn was cut, to ascertain the amount of water required for a pound of dry matter as indicated by the diminished soil moisture and the rains which fell between the planting and harvesting of the corn.

The changes of water content, rainfall, and yield of dry matter are given for 6 plats, 14 by 48 feet, on which Litch dent corn was grown in 1890.

Were it admissible to assume that the percolation of rain water below the surface 4 feet had been exactly equaled by the capillary rise of water into them from below, it would follow from the observed losses of water and yields of dry matter per square foot, that the amounts of water required for a pound of corn were 413.7 pounds for plat 2 and 414.2 pounds for plat 4.

The result of a similar study with the same variety of corn in 1891 gave in one case 309 pounds of water for 1 pound of dry matter on ground which was manured, and 333 pounds on ground not manured. The amount of percolation during the growing season in 1890 was certainly greater than during 1891, and this may or may not be an explanation of the difference in the amounts of water required for a pound of dry matter in the two seasons.

In the case of the oats grown in the field the amount of water required for a pound of dry matter on ground which the year before had been fallow was 519 pounds, and on ground which had not been fallow it was 534 pounds.

Again, the barley of the field showed only 1 pound of dry matter for 537 pounds of water lost from the soil on the ground which had been fallow, and 719 pounds on the ground which had not been fallow. All these statements are made on the assumption that there had been no percolation deeper than 4 feet and no addition of water to the upper 4 feet by capillary action from below, neither of which conditions is likely to have been true. The facts which have been given regarding the rise of water in natural field soils make it appear quite probable that the rise of water into the upper 4 feet from below by capillarity really exceeded the total percolation during the growing season in all the field cases cited, unless possibly the two for 1890 should be excepted.

If we count the rainfall during the growing season and the difference between the amounts of water in the soil at the time of planting and at harvest, in the several field cases, as the amounts used by the crops, including surface evaporation, and then compare these amounts per square foot with those added to the several barrels, we shall get the results given below:

Pounds of water consumed per square foot.

Oats in barrels.		Oats in field.		Mean difference.
No. 1.	No. 2.	Fallow, 1890.	Not fallow.	
101.16 lbs.	102.79 lbs.	73.55 lbs.	72.41 lbs.	28.99 lbs.
Barley in barrels.		**Barley in field.**		**Mean difference.**
No. 1.	No. 2.	Fallow, 1890.	Not fallow.	
77.71 lbs.	80.51 lbs.	59.22 lbs.	58.08 lbs.	20.16 lbs.
Corn in barrels.		**Corn in field.**		**Mean difference.**
No. 1.	No. 2.	Manured.	Unmanured.	
136.89 lbs.	137.71 lbs.	65.24 lbs.	62.35 lbs.	73.50 lbs.

From these figures it appears that while more water was consumed in the field per pound of dry matter produced than in the barrels, the amount of water used per square foot in the barrels was much greater than the measured losses in the field; and these facts are suggestive, though of course not at all demonstrative, that when a sufficient quantity of water is at all times maintained its effectiveness is increased, and that this is one reason, and possibly the chief one, why, the yield per acre being greater, the number of pounds required for a pound of dry matter in the barrels has in every case been smaller than that indicated in the field.

Vertical extent of root feeding (pp. 131-134).—Under this head are recorded the results of observations in 1889 and 1890 on the extent to which corn roots may feed on the soil water, as measured by the change of level of standing water in the soil under fallow ground and that

on which corn was growing. From the facts presented "it may be regarded safe to conclude that under the conditions of good cultivation corn may draw in considerable quantities upon soil water existing at depths greater than 7 feet below the surface."

Soil temperature and terrestrial radiation, M. C. FERNALD (*Maine Sta. Report for 1891, pp. 158–165*).

The periods covered by the experiment were from May 1 to November 1, 1889; from April 1 to November 1, 1890; and from April 1 to November 1, 1891, with thermometers placed in the soil [in an open field] to depths of 1, 3, 6, 9, 12, 24, and 36 inches. * * *

The mean daily range at the depth of 1 inch during the period of observations was 5.55°; at the depth of 3 inches, 4.77°; at the depth of 6 inches, 2°; at the depth of 9 inches, 1.09°; and below 12 inches very slight. * * *

Comparing soil temperatures with air temperatures during the three seasons, the following mean results appear: At the depth of 1 inch the temperature of the soil was lower than that of the air by 2.16°, at the depth of 3 inches by 1.89°, 6 inches by 3.08°, 9 inches by 3.83°, 12 inches by 4.06°, 24 inches by 5.80°, and at the depth of 36 inches by 7.11°.

The mean terrestrial radiation for the three seasons was 6.93° and the greatest range 19.5°.

The air and the soil in their relations to agriculture, H. C. WHITE (*Georgia Sta. Special Bul. No. 17½, July, 1892, pp. 199–211*).—A brief popular discussion of this subject is given, together with tabulated statements of the fertilizing constituents removed from the soil in various farm crops and the analysis of the soil from the station farm.

FERTILIZERS.

W. H. BEAL, *Editor*.

Effect of different forms and mixtures of fertilizers, W. BALENTINE (*Maine Sta. Report for 1891, pp. 123–144*).

Synopsis.—A continuation of experiments begun in 1886 on 36 twentieth-acre plats to compare (1) different forms of phosphoric acid (in dissolved boneblack, fine ground bone, and South Carolina rock), (2) commercial fertilizers with stable manure, (3) partial with complete fertilizers, and (4) the effect of different quantities of fertilizers; together with tests made in 1890 and 1891 of (1) the value of peas preceding grain and (2) the relative ability of different crops to obtain phosphoric acid from crude phosphates.

Previous experiments in this line have been reported in the Annual Reports of the station for 1888 and 1890 (E. S. Bul. No. 2, part II, p. 48, and E. S. R., vol. III, p. 392), where details regarding the soils and fertilizers used, and the methods of their application may be found.

Comparative effect of different forms of phosphoric acid (pp. 126–131).—The results with oats in 1891, and with oats, hay crops, and peas in

preceding years are tabulated. The total yield per acre during the six years was as follows:

Crop.	No manure.	Dissolved boneblack mixture.	Ground-bone mixture.	Ground South Carolina rock mixture.
Oats (three seasons) ....bushels..	121.3	166.5	154	146.4
Peas (one season) .... bushels	12 3	15	15.7	14.3
Hay (one season) .... pounds..	2,566	2,434	2,800	2,566

These results may be summarized as follows:

"(1) On sod land all of the phosphates used in the experiment have been effective; (2) with oats dissolved boneblack has produced on the average the largest crop; (3) with peas and hay there has been but little difference in the effectiveness of the three phosphates used."

Partial vs. complete fertilizers (pp. 131–135).—Dissolved boneblack alone, and mixtures of dissolved boneblack and muriate of potash, muriate of potash and sulphate of ammonia, and dissolved boneblack, muriate of potash, and sulphate of ammonia were each applied on triplicate plats and compared with no manure on 6 plats. The results with oats in 1891 and with oats, hay crops, and peas in preceding years are tabulated. The total yields per acre during six years are given in the following table:

Crop.	No manure.	Muriate of potash and sulphate of ammonia.	Dissolved boneblack.	Dissolved boneblack and muriate of potash	Dissolved boneblack, muriate of potash, and sulphate of ammonia.
Oats (three seasons)..........bushels..	119.5	140.6	124.5	120.8	166.5
Peas (one season) ....bushels..	15.5	12 7	14.2	16.0	15.1
Hay (one season) ....pounds..	2,106	2,336	2,166	2,066	2,434

The results show that as regards the oats and hay crop the largest yields have invariably been produced by the complete fertilizer. They also add weight to the prevailing idea that on ordinary soils peas do not require nitrogenous manures.

"The experiment brings out strongly the facts that (1) for the soil on which it was conducted phosphoric acid and nitrogen are of value as manures; (2) phosphoric acid and potash are the most important fertilizing elements for peas."

Comparative effect of different amounts of fertilizers (pp. 135–137).—Mixtures of dissolved boneblack, muriate of potash, and sulphate of ammonia were applied on triplicate plats seeded to oats, 6 plats remaining unmanured. The ingredients in the different mixtures varied as follows:

Mixture.	Dissolved boneblack per acre.	Muriate of potash per acre.	Sulphate of ammonia per acre.
	Pounds.	*Pounds.*	*Pounds.*
No. 1	200	50	60
No. 2	300	100	120
No. 3	400	150	180

The results for 1891, as well as for similar experiments in previous years, are tabulated in full. A summary of the financial results during six years are given in the following table:

	No manure.	Mixture No. 1.	Mixture No. 2.	Mixture No. 3.
Total value of crops	$80.14	$93.25	$89.04	$99.27
Value of fertilizers	....	15.60	27.60	39.60

"From the investigation this conclusion can be safely drawn: Commercial fertilizers applied at the rate of 300 to 500 pounds per acre are more likely to pay for themselves in increased crop produced than larger quantities."

Systems of manuring—stable manure vs. commercial fertilizers (pp. 138–140).—This is a repetition of the experiments of 1890 on 4 two-and-one-half-acre plats with stable manure 16⅔ cords per acre, and mixtures of untreated South Carolina rock 1,000 pounds and acid South Carolina rock 500 pounds, respectively, with nitrate of soda 66 pounds, sulphate of ammonia 16 pounds, and muriate of potash 100 pounds, oats and clover being substituted for barley and peas of the previous experiment. The results with oats are tabulated. The order of effectiveness of the different fertilizers on oats in 1891 was the same as on barley in 1890, viz, acid South Carolina rock mixture, stable manure, and crude South Carolina rock mixture.

Peas as a crop to precede grain (pp. 140, 141).—In the above experiment the oats were seeded on the plats on which peas had been grown and harvested the previous year. No increase of yield on these plats over those which had previously been in barley was observed.

The relative ability of different crops to obtain phosphoric acid from crude phosphates (pp. 142–144).—This experiment was carried out on the slaty gravel soil of a farm at East Sangerville, Maine, and was a repetition of similar experiments conducted at the same place in 1890.

A field of 3 acres was divided into three parts, each containing just an acre. To the first acre there was applied 500 pounds of dissolved boneblack and 100 pounds of nitrate of soda, to the second 1,000 pounds of raw South Carolina rock and 100 pounds of nitrate of soda, and to the third 500 pounds of a Caribbean Sea guano and 100 pounds of nitrate of soda. Each acre was then divided into 20 plats 1 rod wide and 8 rods long, and duplicate plats were planted with clover, oats, peas, turnips, wheat, barley, corn, beans, and potatoes. Drouth

and insects seriously affected the crops, "but an examination of the [tabulated] yields shows that the dissolved boneblack has given with the majority of them the largest return and the Caribbean Sea guano the least. With peas and turnips South Carolina rock seems to have been more effective than dissolved boneblack."

Spring vs. fall manuring, W. BALENTINE (*Maine Sta. Report for 1891, p. 146*).—The yield per acre of oats on 2 plats, 1 of which was manured in the fall of 1890 at the rate of 5 cords of manure per acre and the other at the same rate in the spring of 1891, are given in a table. Spring manuring gave the largest yield of grain and fall manuring the largest yield of straw.

Coöperative experiments with fertilizers, W. BALENTINE (*Maine Sta. Report for 1891, pp. 146-153*).—Notes and tabulated data are given for experiments with fertilizers furnished by the station, on five farms in different parts of the State. Dissolved boneblack 500 pounds per acre, muriate of potash 100 pounds, and nitrate of soda 150 pounds were applied singly, two by two, and all three together on 14 duplicate plats, 2 plats remaining unmanured. In three cases the crop grown was potatoes, and in one case each barley and corn.

In four out of five of these experiments the increase in the crop was produced at least expense with either potash or phosphoric acid, or a combination of the two. * * * In the fifth experiment [with corn] not only the largest crop, but the crop in which the increase was produced at least expense, came from a manuring with muriate of potash and nitrate of soda.

Use of fertilizers in Minnesota, W. M. HAYS and D. N. HARPER (*Minnesota Sta. Bul. No. 20, May, 1892, pp. 47-64, plate 1*).—In 1890 experiments were undertaken in different parts of the State to determine whether the decline in yield of cereals, especially of wheat, in Minnesota in recent years is due to soil exhaustion or to other causes. Notes and tabulated data are given for plat experiments in three counties of the State with muriate of potash, nitrate of soda, superphosphate, singly and all three combined, salt, lime, plaster, and a complete commercial fertilizer. The crops experimented on were wheat, oats, barley, and flax.

After a brief popular discussion of the nature and use of fertilizers the authors sum up the results of these experiments as follows:

The one fact most prominently brought out is that our better lands are very rich in all kinds of plant food even after having grown crops of wheat for ten to twenty years. Neither nitrogen, potash, nor phosphoric acid when purchased in commercial fertilizers will pay on grain crops on these rich lands. Not even land plaster, salt, or lime will generally return their cost in increased crops while our lands are so rich. In short the time for the general use of commercial fertilizers purchased in markets where we must compete with gardeners and farmers on the worn-out farms of older States and other countries, has not come.

Farmers who have thin, much-worn land should experiment with land plaster and with tankage. The expensive forms of nitrogen, potash, and phosphatic fertilizers will not pay as yet in our young State. Much barnyard manure rich in all these

elements of fertility should be made, husbanded, and intelligently applied to those crops which will get from them the greatest benefit. They not only make the soils richer but keep them moister. * * *

The lessened crops of wheat and other cereals come mainly from causes other than a lack of plant food in the soil. Rusts, unfavorable climatic conditions as to moisture, hot winds, hot sun, etc., chinch bugs, land foul with weeds, too loose mechanical condition of the soil, and poor seed are some of the things which have done far more to lessen wheat yields than a lack of fertility. The study of some of these is of far more present importance than soil analysis or fertilizer trials.

Plaster and castor pomace as fertilizers, C. C. GEORGESON, F. C. BURTIS, and W. SHELTON (*Kansas Sta. Bul. No. 32, Dec., 1891, pp. 238–240*).—The effect of 400 pounds of plaster and 400 pounds of castor pomace on the yield of millet was tested on 15 tenth-acre plats, the plaster and pomace being applied alone. The yields of millet hay are tabulated. "In this instance it appears that the oil meal had the effect of increasing the yield some 600 pounds per acre, which, however, is but a small return for the expenditure of 400 pounds of fertilizer."

A test on 10 tenth-acre plats of the effect of 400 pounds per acre of plaster, the results of which are tabulated, indicate that "on this soil plaster has no effect on the growth of prairie grass." The use of plaster on a field of orchard grass and clover at the rate of 400 and of 800 pounds per acre was without material effect upon the yield of hay. "We conclude that plaster can not be profitably applied to orchard grass and clover on this soil."

Analyses of fertilizers licensed for sale in Vermont in 1892, J. L. HILLS (*Vermont Sta. Bul. No. 29, May, 1892, pp. 12*).—Tabulated analyses and valuations of 41 samples of commercial fertilizers, the trade values of fertilizing ingredients in raw materials and chemicals for 1892, and a comparison on 16 standard brands of the value of fertilizers licensed in 1891 and 1892.

A comparison of the average composition for the two years shows that more nitrogen, less potash, much less phosphoric acid, and less money value by 39 cents per ton were furnished in the average fertilizer in 1892 than in 1891. The average composition this year is lower than that of any previous year since the experiment station began sampling and analyzing licensed fertilizers under the State law. Notwithstanding the fact that the market price of available phosphoric acids has decreased so as to warrant its valuation being lowered a half cent per pound, yet fertilizer manufacturers have decreased the amount of this ingredient in their goods by $1.03 per ton. This is partially counterbalanced by the increased amount of nitrogen.

The average nominal selling price * * * has decreased 27 cents, but * * * it is probable that the decrease in actual cost to the farmer is fully equal to the decrease in value, so that he is obtaining the plant food this year at about the same price as last year.

Analyses of commercial fertilizers (*New York State Sta. Bul. No. 42, n. ser., May, 1892, pp. 64–81*).—Tabulated analyses of 108 brands of commercial fertilizers examined during the spring of 1891.

How can the light soils of north Louisiana be profitably farmed? J. G. LEE (*Louisiana Sta. Bul. No. 16, 2d ser., pp. 481–484*).—This popular article contains suggestions for the management of

small farms and the crops to be raised, with formulas for fertilizers for fruits, cowpeas, corn, and cotton. The importance is urged of raising other crops than cotton and of raising and fattening naimals. Directions are given for making compost with cotton-seed meal.

FIELD CROPS.

A. C. TRUE, *Editor.*

Corn crossing, G. W. MCCLUER (*Illinois Sta. Bul. No. 21, May, 1892, pp. 82–101, plates 4*).—Notes and tabulated data on experiments begun in 1889. A number of the crossed ears are illustrated in the plates accompanying the text. The plan of the experiments and some of the more general results are stated in the following paragraphs taken from the bulletin:

During the first year sixteen ears were produced by crossing varieties of dent corn, no crosses being made between varieties of different colors. Besides the purely dent corn crosses there were made the following:

Male parent.	Female parent.	Ears produced.
Leaming (yellow dent)	Mammoth (sweet)	4
Leaming	Triumph "	3
Leaming	Eight-Rowed (sweet)	3
Gold Coin (yellow sweet)	Mammoth (sweet)	2
Gold Coin	Triumph "	3
Gold Coin	Eight-Rowed (sweet)	2
Stowell Evergreen (sweet)	Mammoth (sweet)	2
Stowell Evergreen	Triumph "	3
Stowell Evergreen	Eight-Rowed (sweet)	4
Queen Golden (pop corn)	A white dent	2
A white dent	Queen Golden (pop corn)	2
Black Mexican (sweet)	Queen Golden	3
Black Mexican	A white dent	3

During the season of 1890 one hundred and fifty-eight ears were produced by crosses between different varieties, or by crossing different stalks within the same variety, or by self-fertilizing, that is, by using the pollen of a stalk on silks of the same stalk. The crosses of varieties different from those of the previous year were:

Male parent.	Female parent.	Ears produced.
Gold Coin (sweet)	Brazilian flour	2
Queen Golden (pop corn)	Common Pearl (pop corn)	4
Brazilian flour	Burr White dent	2
White dent varieties	Yellow dent varieties	6
Yellow dent varieties	White dent varieties	3

In none of the crosses between different varieties of dent corn of the same color or between different varieties of sweet corn of the same color, has there been any change in the crossed ear that could with any certainty be attributed to the pollen. While ears produced by crossing different varieties have varied from each other and from the type of the variety, they have only varied in the same directions and apparently to no greater extent than ears of the same variety left to form naturally. * * *

Ears produced by crossing white sweet corn with pollen of yellow dent corn have been nearly as dark as the male variety, with kernels very much like flint corn in appearance, neither dented nor wrinkled, and with the taste characteristic of dent corn.

Where both sweet and dent kernels appear on the same ear the dent kernels are always the heavier. Kernels were weighed from five ears, each of which had both dent and sweet kernels, with the following results:

		Weight in grams of 100 kernels.
Ear No. 1	Sweet kernels	27.9
	Dent kernels	34.5
Ear No. 2	Sweet kernels	23.4
	Dent kernels	29.5
Ear No. 3	Sweet kernels	39.2
	Dent kernels	47.4
Ear No. 4	Sweet kernels	22.6
	Dent kernels	27.0
Ear No. 5	Sweet kernels	26.4
	Dent kernels	34.8

Color, where it is a character of the kernel and not of the seed coat, tends very strongly to pass from one variety to another. * * *

One of the principal things to be learned from making some of these crosses of widely different varieties is the degree of certainty which can be felt in the work done. For this purpose the crosses in which yellow dent has been the male and white sweet varieties the female, yellow sweet male and white sweet female, and yellow pop corn male and white dent female have been the best. On nineteen ears produced by these various crosses there were found only two kernels which did not show distinctly the effects of the pollen, and these two kernels were pretty certainly not fertilized with the pollen intended. In the case of sweet-corn stalks bearing two ears, where only one was crossed and the other left to be naturally fertilized there was no indication of anything but sweet-corn pollen on the naturally fertilized ears.

The results obtained from planting crossed seed have been of more importance than the immediate effect of crossing, not so much in themselves, perhaps, as in the conclusions which may be drawn from them. None of the purely dent corn crosses have been used for seed; if they had been some of the conclusions drawn from growing the others might have been modified. Parts of most of the ears produced by the other crosses were planted in small plats, 1 by 2 rods, but with little space between them. During the first growing season the uniformity of the crossed plats was very noticeable. Of 142 plats planted with sweet corn, pop corn, and the crosses, it is safe to say there was as much uniformity in the crossed plats as in any, and very much more than was found in most of the plats planted with pure varieties. * * *

The number of rows of kernels on the ear seemed to be modified about equally by each parent. * * * The number of ears to the stalk tended to follow the same type as the stalk. * * *

When the crossed plats were husked the ears from each plat were as uniform as is common with varieties of corn. The corn grown from the crosses of different varieties was plainly modified to about the same extent by each parent. The corn produced by using the pop corn and dent corn as parents seemed to show the effect of the male more than of the female parent, those in which the pop corn was the male parent being more flinty than those in which the dent corn was the male parent. * * *

The corn grown from the crossed seed was in nearly all cases clearly increased in size as a result of crossing. * * *

Corn grown from the crosses the second year has continued to be comparatively uniform in type where the parent varieties were similar; but where the parent varieties were widely different, as in the crosses between sweet and dent, the progeny

has tended strongly to run back to the parent forms, while at the same time taking on other forms different from either. * * *

Nearly all the corn grown the second year from the crosses is smaller than that grown the first year, though most of it is larger than the average size of the parent varieties. The cause of this apparent decrease in size as compared with the previous year can only be guessed at. * * *

From the work so far done there seems to be no way of telling beforehand what varieties will when crossed produce corn of an increased size and what varieties will not. Some of the varieties which may be supposed to be most nearly related, as the sweet corns, have shown but little increase when grown from crossed seed, while 2 varieties of pop corn, which would seem as nearly related to each other as the varieties of sweet corn, gave a very decided increase in size when grown from crossed seed. The corn grown from the cross of Black Mexican and white dent, two widely different varieties, showed a decrease of size, while corn grown from a cross of flour corn and Golden Coin, varieties apparently as widely different as any crossed, gave ears showing the greatest proportionate gain in size. * * *

There seems to be a strong tendency in the progeny of the crosses of the different classes of corn, dent. sweet, and pop, toward corn of the flint type.

Indian corn for forage and for field corn, F. W. WOLL and L. H. ADAMS (*Wisconsin Sta. Report for 1891, pp. 220–226*).

Synopsis.—Varieties of corn from seven Northern and Southern States were grown at the station in 1890, and the yield of dry matter determined in the forage cut September 13 and in the mature stalks and ears harvested October 21 and 22. In the forage the largest yields of dry matter were from varieties from Maryland, Kansas, and Kentucky. In the mature corn the quantity of dry matter in the ears was about equal to that in the stalks and leaves.

Notes and tabulated data are given on the culture, height at different periods of growth, total yield, and yield of dry matter and of protein for varieties of corn from seven States, planted at the station May 28 on clay loam soil. For accounts of previous experiments with corn for fodder see Annual Reports of the station for 1888, 1889, and 1890 (E. S. Bul. No. 2, part I, p. 206, and E. S. R., vol. II, pp. 430 and 452). The yields are tabulated as follows:

Table showing yield and composition of varieties of Indian corn grown in 1890.

Varieties.	Date of harvesting.	Yield.	Dry matter.	Protein in dry matter.	Yield of dry matter	Yield of protein.	Estimated yield per acre.	
							Green fodder.	Dry matter.
Grown for forage.		Lbs.	Per ct.	Per ct.	Lbs.	Lbs.	Lbs.	Lbs.
Wisconsin yellow dent	Sept. 13	249.0	32.96	9.41	82.08	7.72	27,670	9,120
New York yellow flint	Sept. 13	298.0	33 07	9.85	98.54	9.71	33,110	10,950
Maryland Silver Mammoth	Sept. 13	474.0	24.68	8.28	116.9	9 69	49,170	12,130
Kentucky white dent	Sept. 12	445.5	26.99	7.92	120.3	9.40	46,220	19,470
Kansas St. Charles	Sept. 13	481.5	24.90	7.01	119.9	8.40	49,940	12,440
Georgia Red Cob	Sept. 13	427.0	21.41	9.50	91.41	8.68	41,520	8,880
Texas corn	Sept. 13	461.5	20.50	9.75	94.62	9.23	44,870	9,200
Grown for field corn.								
Wisconsin yellow dent	Oct. 21							
Stalks	....	38.0	65.21	7.12	24.78	1.76	....	....
Ears	....	37.25	76.52	10.38	28.49	2 96	....	....
Total	....	75.25	....	....	53.27	4.72	....	....

Table showing yield and composition of varieties of Indian corn, etc.—Continued.

Varieties.	Date of harvesting.	Yield.	Dry matter.	Protein in dry matter.	Yield of dry matter	Yield of protein.	Estimated yield per acre.	
							Green fodder.	Dry matter.
Grown for field corn—Cont'd.		*Lbs.*	*Per ct*	*Per ct.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
New York yellow flint	Oct 21							
Stalks		81.0	43 12	9.10	34 93	3.18		
Ears		51.75	66.39	10.94	34.34	3.76		
Total		132 75			69.27	7.94		
Maryland Silver Mammoth	Oct. 22							
Stalks		95.0	50.53	8.41	47 90	4.03		
Ears		51.25	51.12	10.09	26.20	2.64		
Total		146.25			74.10	6.67		
Kentucky white dent	Oct. 22							
Stalks		108.0	49.43	7.47	53.38	3.99		
Ears		45.25	50.89	8.19	23.03	1.89		
Total		153.25			76.41	5.88		
Kansas St. Charles	Oct. 22							
Stalks		130.0	46.44	9.16	60.37	5.53		
Ears		59.75	51.48	10.00	30.77	3.08		
Total		189.75			91.14	8.61		
Georgia Red Cob	Oct. 21							
Stalks		175.0	40.09	10.01	70.17	7.02		
Ears		22.5	40.21	10.09	9.04	0.91		
Total		197.5			79.21	7.93		
Texas corn	Oct. 22							
Stalks		154.0	44.77	9.91	68.95	6.83		
Ears		32.0	29 78	11.41	9.54	1.08		
Total		186.0			78.49	7.91		

It will be noticed that the quantities of dry matter produced in this case are invariably smaller than when corn was grown for forage; the figures can not, however, be directly compared, as the shocks had to be left standing in the field from September 13 to October 22 in order to dry the ears, and doubtless some of the dry matter was lost through processes of fermentation in the meantime, as investigations conducted at this station have fully satisfied us. In case of the varieties of corn which matured, the quantity of dry matter in the ears is about equal to that in the stalks and leaves. The more immature the variety was, on the other hand, the greater proportion of dry matter was found in the stalks; where only few and imperfect ears were found, as with the Texas and Georgia varieties, about 12 per cent of the total dry matter in the corn was found in the ears.

Corn experiments, J. G. LEE (*Louisiana Sta. Bul. No. 16, 2d ser., pp. 454–462*).—These include fertilizer experiments and tests of varieties.

Fertilizers on corn.—Special nitrogen, phosphoric acid, and potash experiments were made, similar to those with cotton described below. The nitrogen experiments were interfered with by a prolonged drouth, but there was evidence of benefit from the nitrogenous manures. As to the most advantageous form and amount of nitrogen to be applied, the experiments were inconclusive. The conclusions from the phosphoric acid experiments, "if any positive ones can be drawn from these exper-

iments, are similar to those given under cotton." The inference from the special potash experiments is "that potash is not needed in this soil in any form or quantity to grow corn." In an experiment on time of applying manures, made on 12 plats, nitrate of soda, ammonium sulphate, and cotton-seed meal were applied with mixed minerals in single applications at the time of planting and in fractional applications. The yields of shelled corn were small in every case, ranging from 12 to 20 bushels per acre. With ammonium sulphate and nitrate of soda there was an increase in yield from fractional application, but where cotton-seed meal was used the yield was largest from the single application. "Results of previous years declared positively for different applications. The very dry year perhaps prevented the full availability of the second and third applications. We should still conclude it best, however, to divide nitrogen fertilizers intended for corn, and apply at different times during growth."

Corn, test of varieties.—Tabulated results for 28 varieties.

Cotton experiments, J. G. LEE (*Louisiana Sta. Bul. No. 16, 2d ser., pp. 438–454*).—"Experiments with cotton were of three kinds: (1) Manurial tests, embracing nitrogenous, phosphatic, and potassic fertilizers, proper depths, and time and number of applications of each; (2) varieties best adapted to this soil; (3) distances to be given to secure the largest profit."

Fertilizers on cotton.—An experiment was made on 35 plats to compare the effects of nitrate of soda, ammonium sulphate, dried blood, fish scrap, cotton-seed meal, and crushed cotton seed, used alone and in combination with mixed minerals, to determine whether the soil required nitrogen for cotton and if so what nitrogenous fertilizer was best adapted. The variety of cotton was Peterkin and all plats were planted at the same time. The yields of cotton at four different pickings are tabulated. The land was found to be very uneven, but the indications were that the soil needed nitrogen.

> The average per cent of increase due to nitrate of soda is 68, the average of sulphate ammonia is 32, the average of dried blood is 36, the average of fish scrap is 35, that of cotton-seed meal is 45, that of crushed cotton seed is 56, and that of rotten seed is 31 per cent. Nitrate soda is ahead, followed closely by crushed cotton seed, cotton-seed meal, and blood. But the average of the two *mineral* forms of nitrogen, nitrate soda, and sulphate of ammonia is 50 per cent; of the two *animal* forms it is 35; and of the three *vegetable* forms it is 44 per cent. * * *
>
> Concurrent results for three years strongly indicate that on these soils one ration, or 24 pounds of nitrogen per acre, is more profitable than larger quantities. There may be seasons when this quantity can not be assimilated.

The special phosphoric acid experiments were on 25 plats. Here different amounts of dissolved boneblack, superphosphate, bone meal, South Carolina floats, and Thomas slag were used alone and in combination with a basal mixture of cotton-seed meal and kainit. The tabulated results indicate that the phosphates benefited the crop, although the land was very uneven. The greatest benefit was derived

from the more soluble phosphates, dissolved boneblack, and superphosphate. The single ration furnishing 160 pounds of superphosphate seemed to be sufficient. "In every instance except one there is a loss with the double ration. It is certain then that phosphoric acid is needed in this soil to grow cotton profitably, and that excessive quantities entail losses."

In the special potash experiments, which were on 21 plats, potash was applied as cotton-hull ashes, cotton-seed meal, kainit, and muriate and sulphate of potash. The tabulated results show the yields of cotton on the unmanured plats to have been more uniform than in the other experiments. The average yield with potash was only 6 pounds in excess of the yield of the unmanured plats. "There is little difference in the yield of the different forms used. The results declare the soil not in want of potash in any form, combined or uncombined, for cotton."

Two experiments, each on 4 plats, made to compare the yields of cotton with fertilizers (superphosphate, muriate of potash, and cotton-seed meal) as a top-dressing, and at depths of from 2 to 8 inches, gave results in favor of the top-dressing or shallow application.

The tabulated results are given of an experiment on 12 plats, in which nitrate of soda, ammonium sulphate, and cotton seed meal, used in connection with mixed minerals, were applied all at the time of planting and in fractions during the growing season. In general the results were in favor of the application at time of planting.

Cotton, distance of planting.—In an experiment on the distance of planting in which single stalks were grown in drills from 8 to 20 inches apart in the drill and two stalks from 8 to 24 inches apart, "the results are not conclusive, but suggest rather more distance for cotton than is ordinarily given."

Cotton, varieties.—The results are reported of tests of 45 varieties of cotton, including the yield at four separate pickings and the per cent of seed and lint in the total yield of cotton. The station is prepared to furnish small quantities of seed of any of the varieties tested.

Scarlet clover, A. T. NEALE (*Delaware Sta. Bul. No. 16, March, 1892, pp. 15*).—The author describes this valuable forage plant (*Trifolium incarnatum*); compares it with ordinary red clover; makes suggestions as to when, where, and how to sow it, and as to the utilization of the crop; and quotes opinions of it entertained by practical men who have tried it.

In comparison with ordinary red clover its most marked peculiarities are its ability to flourish on relatively poor soils and its development during the fall, winter, and spring, when most of our foul weeds are in seed. * * * [It may be used] to plow down for green manure, for silage, for soiling, for haymaking, for seed production, for eradication of weeds, for reduction of expenses in cultivating orchards, for winter and spring pasture, as a protection for falling fruit in orchards, for binding drift soils and preventing washing on hillsides, and as bee food. * * * In February sixty circular letters were mailed to prominent farmers, asking a number

of questions about this clover. Nearly fifty replies were received. The tabulation shows that 2,343 acres of scarlet clover are now in Delaware on the farms of forty-four men, or more than 53 acres on the average to each man who replied. * * * In no instance has an unfavorable criticism been received.

Forage plants, J. G. LEE (*Louisiana Sta. Bul. No. 16, 2d ser., p. 462*).—An enumeration of the forage plants grown at the station during the year. No results are given. "The soja bean for the first time gave good results."

Field experiments with oats, peas, rape, and timothy, W. M. HAYS (*Minnesota Sta. Bul. No. 20, May, 1892, pp. 35–46*).—Notes and tabulated data are given on experiments in 1890 and 1891 with peas and oats sown separately and in mixture. Either crop sown separately was more profitable than the mixture. The results of a test of 17 varieties of peas in 1891 are reported. The Marrowfat varieties gave the largest average yield. Different methods of seeding field peas were tried with a white variety. The largest yields were from drilling 8 inches apart and seeding at the rate of 3 bushels per acre, and from drilling 24 inches apart and cultivating, seed being sown at the rate of 1.1 bushels per acre.

Rape was successfully grown at the station. Shropshire sheep pastured on rape for thirty-two days in the fall made a gain in live weight of 34 pounds, while the same number of sheep fed on timothy hay during the same period gained only 16 pounds.

With a view to the improvement of timothy grass, seeds of selected plants were gathered in 1889 and sown in good soil the following season. Each plant was given more than a square foot of ground.

It had been observed that the anthers of timothy at the time it is in the "blue bloom" vary in color from light straw color to dark blue. Plants representing the two extremes were marked when in bloom and when ripe the seeds were saved, the intention being to fix the colors as the distinguishing marks of 2 varieties.

The rich soil and ample room caused the plants to make unusually strong growth, and a number of them retained the colors sought to be perpetuated. But this rich feeding forced the plants into a much stronger growth than occurs when crowded together in pasture or meadow. When headed out the second year, the plants then being fifteen months old, each one had spread by stooling to 10 inches or less in diameter, some much more than others. Some had longer heads, were taller, had longer radicle leaves, and were apparently much stronger and more desirable plants than others. Eight of the 324 plants developed some of the spikelets into marked branches. As nearly all the spikes, 20 to 50, on each plant showing this variation had the branches, it is safe to assume that this feature can be made a fixed character by selection in a few to several years.

Experiments with Irish potatoes, J. G. LEE (*Louisiana Sta. Bul. No. 16, 2d ser, pp. 470–479*).—This includes, besides notes on 36 varieties of potatoes tested at the station, experiments with different-sized seed and with fertilizers, and a statement of financial results from growing potatoes.

Size of seed.—Seven varieties of large and medium-sized potatoes were used for seed, being planted whole and cut to two or more eyes and to one eye. The results for each variety from each kind of seed

are tabulated. "The productive results obtained concur with those of previous years; the larger the seed planted the greater the yield. The economical results are, however, different, and calculating for this point, suggest that, planting on a large scale, it is better to cut not to more than four eyes nor less than two."

Fertilizers on potatoes.—The fertilizer experiments were on 21 plats manured with various combinations of nitrate of soda, ammonium sulphate, cotton seed, or cotton-seed meal, with superphosphate, with kainit, and with mixed minerals. The results are fully tabulated.

Potash is a little better than no manure and phosphoric acid better than potash, but neither of marked benefit used alone, even with potatoes on this soil. Green cotton seed and acid phosphate gave best results. Any form of nitrogen gives good results combined with acid phosphate and kainit or alone. Best results come from a combination of cotton seed crushed and green and cotton-seed meal. Previous years bear out the statement. The largest yield, three years ago, came from acid phosphate and crushed cotton seed. Two years ago best results were from acid phosphate and cotton-seed meal, and the past year the largest yield belongs to acid phosphate and green cotton seed.

Financial results.—The receipts in Chicago for the potatoes raised at the station on 1 acre of land manured with 400 pounds of cotton-seed meal, 200 pounds of acid phosphate, and 100 pounds of kainit, were $56.60, deducting charges for freight, cartage, and commissions.

Experiments with potatoes, E. S. GOFF (*Wisconsin Sta. Report for 1891, pp. 135–138*).

Synopsis.—A report on experiments with (1) varieties, (2) planting in hills *vs.* drills, and (3) cutting off the seed ends. The results indicated no great difference of yield from the two methods of planting. Cutting off the seed ends reduced the yield.

Potatoes, test of varieties.—Fifty-nine varieties were tested at the station in 1890. Tabulated data are given for the 10 most productive varieties. These were Burpee Superior, Maine Champion, Pride of the West, Bill Nye, Boley Northern Spy, Delaware, Harris No. 1, Duplex, Dandy, and Seneca Red Jacket.

Potatoes, planting in hills vs. drills.—Experiments in 1890 in planting Rose Seedling potatoes in hills and drills agreed with those of the previous year in showing no great difference in yield from the two methods. "The 34 drilled rows yielded 1,936 pounds of merchantable and 343 pounds of small potatoes, against 1,922 pounds of merchantable and 223 pounds of small potatoes from the 34 rows of hills."

Potatoes, cutting off the seed ends.—Notes and tabulated data on an experiment in which potatoes were planted whole, cut lengthwise, and cut to two eyes, with and without removing the seed ends. When whole tubers were used there was a loss of 22.4 per cent in the yield from removing the seed ends; when the seed was cut to two eyes there was a loss of 2.6 per cent; and when the seed was cut lengthwise there was a very slight loss. These results agree in general with those of the previous year.

Sorghum for sirup, D. N. HARPER (*Minnesota Sta. Bul. No. 21, June, 1892, pp. 98–112*).

Synopsis.—Tabulated analyses of different varieties of sorghum, and of canes cut before and after frost, stripped canes, ripe stalks and suckers, and mill juices. The results favored Early Amber as a sugar-producing variety. Frost did not materially injure the canes. Allowing canes to stand after stripping is injurious, especially if frosts occur. The growth of suckers should be prevented.

Sorghum is largely grown in Minnesota and made into sirup for local consumption, but the supply does not meet the demand and much sirup is imported. The investigations reported relate especially to determinations of the quality of the sorghum grown in the State. Analyses of a number of samples of Early Amber, Kenney Early Amber, and Folger Early, grown at Red Wing, Minnesota, are tabulated and the results compared with those obtained from the same varieties in Kansas.

Average maximum and minimum results of analysis of sorghum.

	Solids.	Sucrose.	Reducing sugar.	Purity.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Early Amber:				
Average of samples taken September 5–October 2	17.01	11.76	2.42	66.69
Average of samples taken September 22–26	17.62	11.49	2.60	70.10
Maximum	20.70	15.33	3.13	79.08
Minimum	13.58	8.34	1.70	54.20
Kenney Early Amber:				
Average	17.90	12.87	1.94	71.84
Maximum	19.16	14.09	2.73	77.23
Minimum	15.06	9.22	1.33	63.59
Folger Early:				
Average	15.95	11.52	2.69	65.28
Maximum	19.38	13.25	3.10	77.94
Minimum	14.24	7.64	2.37	53.65

From seed which had never been specially selected we produced Early Amber of nearly as high average quality as that produced in Kansas from selected seed, and the best of our cane was better than the best of theirs. In Kansas the production of sorghum is for the manufacture of sugar, but with us it must be confined to the manufacture of sirup, with the production of sugar incidental. * * * In addition to the causes which have operated unfavorably elsewhere, our short season for working up the cane has been considered fatal to sugar manufacture here, but our results seem to indicate that this feature may not be a fault. Hard frosts occurred September 27, 28, and 29, before any cane had been cut. On the 29th the Early Amber was stripped and harvested and made into an excellent sirup. To study the effects of frost upon standing cane some rows were not cut down at all, and analyses were made of sample canes from day to day. The averages of the daily analyses are arranged in the following table:

Analyses of Early Amber sorghum before and after frost.

Date.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Before frost:				
September 22	17.51	12.98	2.33	74.00
September 24	18.17	13.14	2.15	79.19
September 26	18.80	13.49	2.21	71.13
After frost:				
September 27	17.51	11.70	2.77	68.83
September 29	15.56	10.42	2.61	66.96
October 1	17.42	12.27	2.14	72.08
October 2	16.23	11.46	2.04	70.66
October 4	14.30	1.99	....	....
October 10	12.04	2.34	....	....

Naturally a general decrease in the density of the juice occurred after frost, but that there was so little inversion of the cane sugar seemed quite remarkable. This may be explained from the fact that the temperature did not at any time after frost rise sufficiently high to permit of much fermentation. * * * Our results would show that the proper practice is to allow the cane to grow until it matures and not cut it while yet unripe in apprehension of frost. If, however, frost should occur, let it be cut, tied in small bundles, and piled in the shade in such a way that air can have free circulation throughout the piles. It should then be made up into sirup as quickly as possible.

[Analyses of Early Amber canes stripped September 24 are given as follows:]

Analyses of stripped canes before and after frost.

Date.	Solids.	Sucrose	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Before frost:				
September 24	15 94	10.03	3 67	62.46
September 26	19.60	14.86	2.58	75.67
After frost:				
September 27	18.40	12.42	2.38	67.60
October 1	14.60	9.38	2.40	64.06
October 2	15.82	10.10	2.33	65.91
October 4	13.54	....	2.88	....
October 10	13.87	2	3.23	....

More glucose, less sucrose, and lower purity resulted in the stripped canes, and frost caused more damage to them than to canes in their natural condition. But the effects of stripping cane were quite marked in the working of it in the factory. Cane which had been stripped was much more difficult to work up than the other, and this showed itself particularly in the evaporation of the juice to sirup. So that for all reasons it proved to be a wrong practice to let stripped cane stand.

[Analyses of ripe stalks and suckers, which indicated that the growth of suckers should be prevented, are given as follows:]

Analyses of stalks and suckers of sorghum canes.

	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Main stalk	14.48	8 50	3.05	58 70
Suckers of same	13.78	7.10	3.94	51 52
Main stalk	16.42	11 60	2.57	70.64
Suckers of same	18.02	12.62	....	70.03
Main stalk	15.60	10.42	2.61	66.79
Suckers of same	14.00	7.71	2.96	55 07
Stalk, no suckers	20.22	14.61	2.75	72.25
Stalk, no suckers	20.32	15.33	1.88	75.44

Analyses of mill juices from cane raised by forty-four different farmers are tabulated, showing wide variations in the sucrose and glucose content, largely due to differences in the ripeness of the cane when cut and in the care with which it was piled in the field.

Analyses of the juice which had been exposed to the air in tanks thirty-six hours showed an average increase of glucose of only 0.095 per cent. The smallness of the inversion resulting from the long exposure of the juice would greatly facilitate the manufacture of sorghum sugar in the cool climate of Minnesota if this industry should ever become practicable there.

Sugar beets in Iowa, 1891, G. E. PATRICK, E. N. EATON, and D. B. BISBEE (*Iowa Sta. Bul. No. 17, May, 1892, pp. 393–418, figs. 4*).

Synopsis.—A continuation of the work on sugar beets recorded in Bulletin No. 15 of the station (E. S. R., vol. III, p. 782). Klein Wanzleben and Vilmorin varieties were tried on different kinds of soil in different parts of the State with results slightly favoring the latter variety. There are also notes on experiments with different methods of culture, brief reports from individual growers, statements regarding implements for beet culture from Bulletin No. 21 of the Nebraska Station (E. S. R., vol. III, p. 800), abstracts of reports of United States consuls and commercial agents in Europe on beet culture, and hints to American farmers by Prof. Veith of Austria-Hungary.

The results are tabulated of analyses of Klein Wanzleben and Vilmorin beets grown at Muscatine, Des Moines, Fort Dodge, and other localities in the State. These analyses are arranged according to variety of beet and kind of soil. The quality of the Vilmorin beets averaged a little higher than that of most of the Klein Wanzleben beets. The samples of both varieties from Muscatine averaged higher in quality than those from any other part of the State. Of the Muscatine beets those grown on sandy soil with sandy subsoil were the best. In a comparison based on 15 samples from other parts of the State those grown on "clay, clay loam, or timber clay" soils showed the highest average quality. The average results of tests on all the different kinds of soil were as follows:

Analyses of sugar beets grown on different soils.

Region of growth.	Klein Wanzleben.			Vilmorin.		
	No. of samples.	Sugar.	Purity of juice.	No. of samples.	Sugar.	Purity of juice.
		Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
Muscatine	18	14.55	77.66	75	14.70	79.18
Des Moines	50	11.22	70.84	21	11.80	73.01
Fort Dodge	8	10.89	72.54	4	11.56	74.61
Miscellaneous	36	11.00	71.50	42	11.86	73.51
Mean	112	11.66	72.27	142	13.34	76.47
Mean, omitting Muscatine	94	11.11	71.24	67	11.82	73.42

Analyses of sugar beets, D. N. HARPER (*Minnesota Sta. Bul. No. 21, June, 1892, pp. 69–93*).—Tabulated analyses of a considerable number of samples of sugar beets grown in 1891 at the station and in different localities of Minnesota. Those grown at the station showed a high sugar content (averaging 17 per cent in samples taken October 1). The results from samples grown by farmers varied greatly, but in general the indications were that with proper care in the culture of the crop beets with a satisfactory sugar content can be raised in Minnesota.

Experiments in the culture of sugar beets, W. M. HAYS (*Minnesota Sta. Bul. No. 21, June, 1892, pp. 94–97*).—The cost of raising sugar beets on weedy land at the station in 1891 was $3.25 per ton, on clean land $2.09. The results of planting different amounts of seed indicated that about 20 pounds per acre is required. A test of varieties

is reported. Knauer Imperial gave the largest yield. Plowing to a depth of about 9 inches gave the best results.

Sugar beet culture in Wisconsin, F. W. WOLL (*Wisconsin Sta. Report for 1891, pp. 176–192*).—A reprint of an article in Bulletin No. 26 of the station (E. S. R., vol. II, p. 671).

Sugar cane, J. G. LEE (*Louisiana Sta. Bul. No. 16, 2d ser., pp. 479–481*).—The results are tabulated of the yield of cane at the station and the analysis of the juice. "The stand of cane on the station was poor, and this, together with two prolonged drouths with which it had to contend, resulted in a rather low yield."

Sundry crops, J. G. LEE (*Louisiana Sta. Bul. No. 16, 2d ser., pp. 462–470*).—Brief notes are given on the Spanish peanut, 11 varieties of cowpeas, 5 of sweet potatoes, 16 of melons, 10 of cantaloupes, 21 of strawberries, 5 of wheat, 1 each of rye, oats, and rice, and the yields of hay from 16 different grasses. In an experiment with oats and with barley, in which a mixture of cotton-seed meal and superphosphate was applied either at the time of planting or as a top-dressing in February, the results were in favor of the application at the time of planting.

Growing wheat and oats separately and in mixtures, W. BALENTINE (*Maine Sta. Report for 1891, pp. 144, 145*).—The results obtained on 6 plats, 43.6 by 240 feet, seeded to oats (12 pounds per plat), wheat (24 pounds), or a mixture containing oats (8 pounds) and wheat (8 pounds), were "decidedly in favor of oats separately as compared with oats and wheat mixed, and oats and wheat mixed as compared with wheat alone."

Rotation of crops, J. G. LEE (*Louisiana Sta. Bul. No. 16, 2d ser., pp. 436–438*).—"Several years ago the following rotation was decided upon as the best combination attainable in this section: This rotation is corn, oats followed by cowpeas, and cotton. This rotation is faulty in principle but correct in practice, and was adopted last season after two years' trial. The corn should precede the cotton, but experience has demonstrated that Rust-Proof oats, the only variety successfully grown here, must be planted in October if maximum results are desired. Cotton can not be removed in time for this crop, while corn can."

This rotation was begun in 1889 on plats with and without fertilizers. The yields in 1889, 1890, and 1891 are tabulated. The experiments are to be continued.

Losses in ensiling and field-curing Indian corn, F. W. WOLL (*Wisconsin Sta. Report for 1891, pp. 227–231*).

Synopsis.—In the fall and winter of 1890 a comparison was made of the losses of dry matter and protein in samples from 65 tons of Indian corn put into a single silo at the station and from field-cured fodder left out of doors during most of the winter. In the silage the loss of dry matter was 10.3 per cent and of protein 12.5 per cent. In the field-cured fodder the loss of dry matter was 28.3 per cent and of protein 34.8 per cent. The average losses in ensiling and in field-curing Indian corn, as determined during the last four years' experiments at this

station, amount to 15.6 per cent and 16.8 per cent for dry matter and protein, respectively, for the silage, and 23.8 per cent and 24.3 per cent for dry matter and for protein, respectively, for the field-cured fodder.

The experiments here reported were in continuation of those recorded in the Annual Reports of the station for 1888, 1889, and 1890 (E. S. Bul. No. 2, part I, p. 206, and E. S. R., vol. II, pp. 430 and 449). September 2–9, 1890, a station silo with a capacity of 80 tons was filled with alternate layers of Burrill and Whitman Ensilage and Pride of the North corn cut into pieces three fourths of an inch in length.

In all 129,014 pounds were cut for the silo. On the top of the green fodder corn 3,800 pounds of green millet were put for a covering. The silo was opened December 12 and we began feeding from it at once. About 6 inches from the top layer had spoiled, otherwise the silage was good close up to the walls of the silo. The greater portion of the silage was fed out in the feeding experiment reported elsewhere [E. S. R., vol. IV, p.178], and samples from the same were taken once every week, so that in all seventeen samples were obtained from the silo; separate analyses were made of the same for dry matter and protein content.

The shocked fodder corn was left in the field until a little before it was needed for feeding in the experiment (December 15–April 13). Most of the fodder was therefore left out during the greater part of the winter. The fall was very wet and damp, but the winter was rather dry and with much clear, sunshiny weather, so that it may be said in general that the season was favorable to this system of preserving Indian corn. The dry fodder was fed in the same experiment as was the silage, and sampled every week. The following table gives in a condensed form the total quantities of silage and of field-cured fodder corn obtained from the land, and the quantities of dry matter and protein in both cases:

Loss of dry matter and protein in ensiling.

	Put into the silo.	Taken out.	Difference.	Loss.
	Pounds.	*Pounds.*	*Pounds.*	*Per cent.*
Weight of fodder	129,014.0	105,824.0		
Weight of dry matter	32,432.0	29,090.0	3,342.0	10.3
Weight of crude protein	2,580.5	2,557.0	323.5	12.5

Loss of dry matter and protein in field-curing.

	In fresh shocks.	In cured shocks.	Difference.	Loss.
	Pounds.	*Pounds.*	*Pounds.*	*Per cent.*
Weight of fodder	129,014.0	31,738.0		
Weight of dry matter	32,432.0	23,270.0	9,162.0	28.3
Weight of protein	2,580.5	1,682.0	898.5	34.8

The table shows that the losses of dry matter and protein as found by us during the past year were considerably larger in the field-curing than in the ensiling. The work in this line at this station is summarized in our Seventh Annual Report on pages 226 and 235 [E. S. R., vol. II, p. 453]. We found that on the average 20 per cent of dry matter was lost in case of both systems. The reason why the losses in ensiling came so much lower in last year's experiment is doubtless that a larger quantity of green fodder was ensiled than ever before, viz, 65 tons. It is believed that in last year's work we have come nearer to the actual losses that take place in most of the silos of this country. * * *

A few shocks of Indian corn were put up during last fall from the corn grown for the sake of comparison of different varieties. The shocks were left out for exactly

three months (from September 13 to December 13). The data, as regards the loss of nutrients, are given below:

Table showing losses of dry matter and protein in field-curing fodder corn.

	Weight of shocks.		Dry matter in shocks.				Protein in shocks.			
	Sept. 13.	Dec. 13.	Sept. 13.	Dec. 13.	Loss.	Loss.	Sept. 13.	Dec. 13.	Loss	Loss
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Per cent.*	*Lbs.*	*Lbs.*	*Lbs.*	*Per cent.*
Wisconsin yellow dent	87.0	34.0	30.16	27.41	2.75	9.1	2.73	2.07	0.66	24.2
New York yellow flint	104.0	38.0	36.59	29.46	7.13	19.5	3.41	2.41	1.00	29.3
Maryland silver mammoth	232.5	61.0	57.37	42.77	14.60	25.5	4.75	2.85	1.90	40.0
Kentucky white dent	212.5	67.0	57.36	48.38	8.98	15.7	4.49	2.44	2.05	45.7
Kansas St. Charles	226.0	72.0	56.27	50.70	5.57	9.0	3.95	3.04	0.91	23.0
Georgia Red Cob	214.0	69.0	45.81	40.24	5.57	12.2	4.35	2.98	1.37	31.5
Total	......	....	283.56	238.96	44.60	15.7	23.68	15.97	7.89	33.3

The average losses found for all the shocks are in this case 15.7 per cent of dry matter and 33.3 per cent of protein; these losses are somewhat lower than found in the experiment just reported, as would naturally be supposed, as the shocks in this case were left out for a shorter time. They were out in the fall, however, when we had hard rain storms and much damp weather, which would make the losses greater during this period.

If we summarize last season's work with that of the preceding three years, in the same way as was done in last year's report, we have the following table:

Average losses in ensiling and field-curing Indian corn; results of four years' work.

	In original fodder.	As fed out and sampled.	Difference.	Loss.
	Pounds.	*Pounds.*	*Pounds.*	*Per cent.*
A.—*Ensiling.*				
Total quantity of—				
Dry matter	68,034.3	57,410.7	10,623.6	15.6
Protein	5,490.8	4,569.5	921.3	16.8
B.—*Field-curing.*				
Total quantity of—				
Dry matter	72,163.6	54,937.0	17,226.6	23.8
Protein	5,706.4	4,317.5	1,388.9	24.3

The average losses of dry matter in ensiling Indian corn, according to these results, are 15.6 per cent, and in field-curing the same fodder 23.8 per cent. For reasons already given, we feel inclined to believe that the former result may still be too high, owing to the small quantity of fodder ensiled in previous years' experiments. Our work in this line would therefore lead us to the conclusion that the losses sustained in the field-curing and field-storing of Indian corn greatly exceed those in ensiling.

Construction and filling of silos, F. H. KING (*Wisconsin Sta. Report for 1891, pp. 232–280, figs. 7*).

Synopsis.—A reprint of Bulletin No. 28 of the station (E. S. R., vol. III, p. 248), with additional data on the following topics: (1) Importance of lateral pressure and of rigid silo walls, (2) weight of silage per cubic foot two days after filling, (3) dimensions of silos required to give the proper horizontal feeding areas, (4) lateral pressure of silage, (5) size and distance apart of studding in rectangular silos, (6) action of silage juices on different varieties of hydraulic cement, (7) construction of a round silo, (8) rack for silage corn, (9) amount of labor required to put corn into the silo.

Importance of lateral pressure and of rigid silo walls (pp. 240, 241).—Strong lateral pressure is of extreme importance in preventing the decay of silage along the side walls. Unless the silage presses firmly on the walls—

The high temperature of the silage maintains convection air currents between it and the walls, which rapidly promote decay and this widens the air passages so that rotting is pushed forward at an increasing rate. * * *

[Again, since the ordinary silo is not absolutely air-tight], the pressure and suction effects of the winds on the walls outside and the slow but constant diffusion of air combined with convection currents just referred to, make the exchange of air between the inside and outside of the silo much more rapid where the silage is not pressed hard against these innumerable small openings. * * *

[It follows that the silo walls should be so rigid as not to be sprung outward to any considerable extent.] Where the walls do yield under silage pressure the greatest bending occurs at a point below the center, and this leaves the silage in the upper half of the silo to settle into a pit which widens downward, and this tends to leave that portion of the silage after settling pressing against the walls very lightly or not at all.

The strong lateral pressure necessary to good silage can not safely be secured by making the silo wider at the top and leaving it shallow, for then the lack of sufficient downward pressure endangers the whole silage, while the flaring sides, by increasing the dragging of the silage, make the downward pressure less than it would be were the walls vertical.

Weight of silage per cubic foot two days after filling (pp. 241–244).

The station silos, which are 14 feet deep, were filled this year with Pride of the North corn, a little overripe, to a depth of 13 feet. The silage was cut in half-inch sections and continuously tread during the filling, which lasted about one week, and had a mean weight at the close of 24.75 pounds per cubic foot. In 1890, when filled to a depth of 12 feet with the same variety of corn, but greener, the mean weight was 27.9 pounds. Prof. F. E. Emery in Bulletin No. 80 of the North Carolina Experiment Station, mentions having filled several silos to a depth of 14 feet where the mean weight was less than 26 pounds per cubic foot. He cites another silo 31½ feet deep filled with King Philip corn where the silage weighed in averaged only 34 pounds per cubic foot, but which settled so as to average 41.8 pounds supposing no loss to have occurred. Two of the New York State Station silos, 14 feet deep, each filled in two days, averaged when full 25.9 and 25.7 pounds per cubic foot, but settled in 24 days so as to average 32 pounds. A Missouri Experiment Station silo, 16 by 22, 16 feet deep, held 85 tons, making an average of 30 pounds per cubic foot. The silage in one of the Kansas Experiment Station silos, filled so as to be 20 feet deep two days after filling, had an average weight of nearly 34 pounds per cubic foot. The round silo of Mr. C. E. King, Whitewater, Wisconsin, which is 22.75 feet inside diameter and 31 feet deep, contained at the completion of filling, when the silage was 27 feet deep, 490,694 pounds, as nearly as could be determined by weighing rows in different portions of the fields and multiplying these weights by the number of rows, or a mean of 44.6 pounds per cubic foot. In this case the corn was part flint and part a small variety of dent, both well glazed, a little dry owing to the drouth, and cut into the silo in 1 to 1.5 inch lengths, without treading, the silage being leveled once daily.

Since the water of silage weighs about 62.4 pounds per cubic foot and since the solid constituents are about 1.5 times heavier than water, it follows that a cubic foot of silage may weigh more than 62.5 pounds. With silage containing 30, 25, and 20 per cent of dry matter, the possible weights per cubic foot are near 71.76, 70.2, and 68.64 pounds respectively.

In the Rothamsted silo No. 1, which is 15 by 13.83 feet and 22 feet deep, it is stated * that 217,694 pounds of first crop clear clover containing 46,653 pounds of dry matter were run through a chaffer into it, thoroughly tread during the operation, and then weighted with 90 pounds per square foot. Later the weights were removed and 46,624 pounds of second-crop clover, containing 8,920 pounds of dry matter, were cut in and again similarly weighted, when the silage was found to be only 18 feet deep and to measure 3,706 cubic feet. Under these conditions, had there been no loss, the silage must have weighed 71.3 pounds per cubic foot. Of course there had been a loss, and the figures suggested about 4.17 per cent of the total green weight. It is not stated how nearly full the silo was when the first crop was put in and weighted, but had it been within 2 feet of the top the mean weight per cubic foot must have been 52.4 pounds, and if we suppose the silo to have been full after weighting, which is improbable, the mean weight must still have been 47.7 pounds. In feeding out the silage the average weight of the upper 4 feet was found to be 45.5 pounds and that of the lower 4 feet 59.5 pounds, with a general average of 53.6 pounds per cubic foot.

The writer found the silage in the round silo referred to above to weigh at the time of feeding 45.2 pounds per cubic foot at a mean depth of 12.79 feet below the level at which the silage was when filling ceased, ninety-four days earlier.

If we take the mean weight of well-glazed corn silage, cut in slowly to a depth of 27 feet, at 42 pounds per cubic foot (which is 2.6 pounds below that computed for the round silo cited above), the upper 13 feet as averaging 26 pounds, 45 pounds as the weight of a cubic foot 13 feet below the surface, all of which are given above, and then assume that below this 13-foot level the weight per cubic foot increases uniformly until 63 pounds is reached, the weight of a cubic foot of silage at different depths may be computed, and the average weight of a cubic foot also for silos having different depths. In order that 63 pounds may be the maximum possible weight of silage per cubic foot less than 3 per cent of dry matter is demanded, and if the silage contains 20 per cent of dry matter, a weight of 63 pounds per cubic foot demands that there shall be more than one eighth of the space unoccupied by either water or solids. The results given below can of course be regarded only as rough approximations to what may actually occur under the varying amounts of water the corn may contain at the time it is put in, and the following table is given only because nothing more exact appears attainable with existing data:

Table showing the computed weight of glazed corn silage at different distances below the surface and the computed mean weight for silos of different depths two days after filling.

Depth of silage.	Weight of lower cubic foot of silage.	Mean weight of silage per cubic foot.	Depth of silage.	Weight of lower cubic foot of silage.	Mean weight of silage per cubic foot.
Feet.	*Pounds.*	*Pounds.*	*Feet.*	*Pounds.*	*Pounds.*
14	45	27.3	24	63	39.2
15	47	28.7	25	63	40.2
16	49	29.9	26	63	41.0
17	51	31.2	27	63	41.9
18	53	32.4	28	63	42.6
19	55	33.6	29	63	43.3
20	57	34.8	30	63	44.0
21	59	35.9	32	63	45.2
22	61	37.0	34	63	46.2
23	63	38.2	36	63	47.1

It is evident from the facts given that the storage capacity of silos increases more rapidly than the depth until the weight has become great enough to compress the silage to its maximum limit, and that beyond this the capacity increases directly as the depth.

* Rothamsted Memoirs, vol. IV.

Dimensions of silos required to give the proper horizontal feeding areas, (pp. 246, 247).—With the aid of the data given in the table of the weight of a cubic foot of silage at different depths, the dimensions for two depths of silos have been approximately calculated in the following table:

Table giving inside dimensions of silos which will allow the silage to be fed down at a mean rate of about 2 or 3 inches daily, assuming 40 pounds of silage, at time of filling, to be fed each cow daily. Capacity of each silo sufficient for one hundred and eighty days.

No. of cows.	Silo 30 feet deep without partition.					Silo 24 feet deep with partition.				
	Contents.		Round, diameter.	Square sides.	Mean depth fed daily.	Contents.		Round, diameter.	Square sides.	Mean depth fed daily.
	Tons.	*Cu. ft.*	*Feet.*	*Feet.*	*Inches*	*Tons*	*Cu. ft.*	*Feet.*	*Feet.*	*Inches.*
30	108	4,091	15.00	12×14	2	108	5,510	17.00	16×16	3.2
40	144	6,545	16.75	14×16	2	144	7,347	20.00	18×18	3.2
50	180	8,182	18.75	16×18	2	180	9,181	22.00	20×20	3.2
60	216	9,818	20.50	18×18	2	216	11,020	24.00	22×22	3.2
70	252	11,454	22.00	20×20	2	252	12,857	26.00	22×26	3.2
80	288	13,091	23.50	20×22	2	288	14,691	28.00	24×26	3.2
90	324	14,727	25.00	22×24	2	324	16,531	29.75	26×28	3.2
100	360	16,364	26.50	24×24	2	360	18,367	31.25	28×28	3.2

Lateral pressure of silage (pp. 249–253).—With a view to ascertaining the amount and variation of the lateral pressure of silage on the silo walls, experiments were conducted in a round silo 34 feet deep with an inside diameter of 22.75 feet.

Four pressure plates were used, placed at different heights above the bottom of the silo and on different sides, and the following table gives the observed pressure per square foot, the dates on which they were measured, and the depth of silage above the center of the plates at the times the observations were made. Plate 1 had its center 3 feet 1.5 inches above the bottom of the silo; plate 2, 7 feet 5 inches; plate 3, 12 feet 4.5 inches, and plate 4, 16 feet 4.5 inches above the bottom.

Table showing observed pressures of silage per square foot in a round silo at the time of filling.

Date.	Plate 1.		Plate 2.		Plate 3.		Plate 4.		Remarks.
	Depth.	Pressure per square foot.	Depth.	Pressure per square foot.	Depth.	Pressure per square foot.	Depth.	Pressure per square foot.	
	Feet.	*Pounds.*	*Feet.*	*Pounds.*	*Feet.*	*Pounds.*	*Feet.*	*Pounds.*	
Sept. 3	......	......	3.83	40.0	......	......	......	......	
7	......	......	5.83	65.0	......	......	......	......	
8	......	......	......	72.5	......	......	......	......	
11	15.38	150.9	11.46	125.0	6.13	62.5	2.13	15.0	
12	14.25	150.9	10.33	132.5	5.00	67.5	1.00	15.0	Before leveling.
12	15.75	176.9	11.83	135.0	6.50	75.0	2.50	35.0	After leveling.
15	18.04	200.2	14.13	180.0	8.79	140.0	4.79	55.0	Noon.
16	......	212.6	......	170.0	......	155.0	......	55.0	Morning.
18	......	219.4	......	160.0	......	146.0	......	70.0	Before leveling.
18	19.38	212.6	15.46	180.0	10.13	148.0	6.13	80.0	After leveling.
19	......	222.9	......	170.0	......	146.0	......	75.0	Filling finished.
22	23.88	236.6	19.96	200.0	14.63	147.5	10.63	85.0	
24	......	226.3	......	207.5	......	165.0	......	86.0	
30	21.88	212.6	17.96	190.0	12.63	133.0	8.63	95.0	

If we divide the pressure per square foot as given in the table by the depth of silage above the centers of the several plates on the different dates, we get the results given below:

Table showing the mean pressure of silage per square foot for each foot in depth of silage.

Date.	Plate 1.		Plate 2.		Plate 3.		Plate 4.	
	Depth of silage	Pressure per foot of depth	Depth of silage.	Pressure per foot of depth.	Depth of silage.	Pressure per foot of depth.	Depth of silage	Pressure per foot of depth.
	Feet.	*Pounds.*	*Feet*	*Pounds.*	*Feet.*	*Pounds.*	*Feet.*	*Pounds.*
Sept. 3	......	......	3.83	10.43	......	......	......	......
7	......	......	5.83	11.14	......	......	......	......
11	15.38	9.81	11.46	10.91	6.13	10.20	2.13	7.06
12	15.75	11.23	11.83	11.41	6.50	11.54	2.50	14.00
15	18.01	11.10	11.13	12.74	......	......	4.79	11.48
18	19.38	10.97	15.46	11.64	10.13	14.62	6.13	13.06
22	23.88	9.91	19.96	10.02	14.63	10.09	10.63	8.00
30	21.88	9.72	17.96	10.58	12.63	10.53	8.63	11.01
Mean	......	10.46	......	11.11	......	11.40	......	10.77

This table shows that in the silo under experiment the pressure increased at an approximately constant rate of about 11 pounds for every foot in depth of silage. There are considerable variations shown in the table it is true, but from the character of the silage, its heating and settling, and the necessarily only approximately exact method of measurement of the actual pressures, the variations as a rule are not larger than should be anticipated. * * *

The corn cut into the silo was partly flint and partly one of the smaller varieties of dent, all of it being well advanced toward maturity and the lower leaves often dry or wilted on account of the drouth. The field-cutting occurred no faster than the corn was put into the silo, all of it being cut into sections from 1 to 1.5 inches long.

The results here reported are much larger than those obtained by Prof. Shelton as reported in the First Annual Report of the Kansas Experiment Station, his average being only 3.59 pounds for each foot in depth of silage, as compared with 10.91 pounds in these trials. * * * Practical experience proves beyond a doubt that the pressures are greater than those indicated by Prof. Shelton's results, and I see no way of avoiding the conclusion that, in the case here reported, the pressures were as great as the tables presented indicate, and I believe they will be found close to the truth for most cases.

Size and distance apart of studding in rectangular silos (pp. 259-264).—A formula by Prof. C. B. Wing for calculating the safe pressure and amount of bending of studding in the walls of rectangular silos is given and explained in detail. It is based on the assumption that the pressure of the silage increases in proportion to the depth, as observations seem to indicate. From this formula the following calculations were made:

Table showing for each stud in rectangular silos the computed safe pressure, the computed actual pressure at time of filling in full silos of different depths, with studding different distances apart, and the maximum amount of bending in each case, where white pine is used.

Depth of silo.	Size of studding.	Safe total pressure.	Computed pressure per stud and amount of bending. Distances between studding. 12 inches. Total pressure.	12 inches. Bending.	16 inches. Total pressure.	16 inches. Bending.	18 inches. Total pressure.	18 inches. Bending.	24 inches. Total pressure	24 inches. Bending.
Feet.		*Pounds.*	*Pounds.*	*Inches.*	*Pounds.*	*Inches.*	*Pounds*	*Inches.*	*Pounds.*	*Inches.*
16	2×8	1,733	1,408	1.00	1,877	....	2,112	....	2,816	....
	2×10	2,708		0.52		0.69		0.78		1.04
18	2×8	1,541	1,782	1.83	2,376	....	2,673	....	3,564	....
	2×10	2,408		0.94		1.25		1.40		....
	2×12	3,467		0.54		0.72		0.81		1.08
20	2×10	2,167	2.200	1.58	2,933	2.11	3,300	....	4,400	....
	2×12	3.120		0.92		1.22		1.37		1.83
22	2×10	1,970	2,662	2.55	3,549	....	3,993	....	5,324	....
	2×12	2,836		1.48		1.97		....		....
24	2×12	2,600	3,168	2.28	4,224	....	4,732	....	6,336	....

Depth of silo.	Size of studding.	Safe total pressure.	Distances between studding. 6 inches. Total pressure.	6 inches. Bending.	8 inches. Total pressure.	8 inches. Bending.	9 inches. Total pressure.	9 inches. Bending.	10 inches. Total pressure.	10 inches. Bending.
26	2×10	1,667	1,859	2.94	2,479	....	2,789	....	3,098	....
	2×12	2,400		1.70		2.27		2.55		2.83
28	2×12	2,229	2,156	2.47	2,875	3.29	3,234	....	3,593	....
30	2×12	2,080	2,475	3.48	3,300	....	3,713	....	4,125	....

The pressures given in the two preceding tables and the amount of bending in the last table should be understood as applying most closely to the studs nearest the centers of the sides of rectangular silos, for in this type of structure the pressure must diminish in some undetermined ratio toward the corners, where it becomes smallest. In round silos all vertical strips, of unit width, sustain uniform pressures, and in the octagonal types there is a closer approximation to this condition than in the rectangular.

Action of silage juices on different varieties of hydraulic cement (pp. 266–268).

It was learned through a careful examination of thirty-nine silos in which some variety of cement or common lime mortar had been used, that such linings are softened by the silage juices. To procure further evidence as to the effect of the acids found in silage upon known varieties of cement when made up with different proportions of sand, 6 varieties were procured upon the market for trial and each made up with sand in two proportions, one third cement and two thirds sand, and two fifths cement and three fifths sand.

The cement was applied to the four sides of pieces 2 by 4 studding 3 feet long, which had previously been covered with lath as for ordinary plastering. After standing twenty days to season, and after receiving a coat of whitewash made of the respective varieties of pure cement, to close up season checks, the two samples of each variety were placed together in barrels of water containing 0.0356 per cent of lactic acid and 1.972 per cent of acetic acid. The samples being 3 feet long, the upper 18 inches of each sample was outside of the solution and served as a basis of comparison of the extent of softening by the acid.

The samples remained in the acid solution twenty-four days and the relative degree of action of the acids was determined by securing a piece of steel $\frac{1}{16}$ inch thick and $\frac{1}{2}$ inch wide in the jaws of a heavy wrench, by which it could be moved to

and fro over the surface of the cements under a constant and known weight. The end of the piece of steel was filed square, held vertical to the surface of the cement, and moved to and fro twenty times in the same place under a pressure of 2 pounds, cutting a groove ¼ of an inch wide. Four trials were made upon the portion of each sample which had been in the acid and one upon the portion outside, the results of which are given below:

Table showing the amount of softening of different varieties of cement in water containing acetic and lactic acid.

Kinds of cement.	One third cement, two thirds sand.					Two fifths cement, three fifths sand.				
	1	2	3	4	Average.	1	2	3	4	Average.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
Portland	0.061	0.057	0 051	0.039	0.052	0.020	0.046	0.048	0.038	0.038
Akron...........	0.053	0.118	0.055	0.051	0 069	0.059	0.049	0.049	0.058	0.054
Louisville	0.298	0.284	0 198	0 291	0 268 (?)	0.052	0.052	0.086	0.055	0.061
Utica............	0.152	0.138	0.110	0.110	0 128	0 056	0.068	0 076	0.081	0.070
Buffalo	0.177	0 240	0.202	0.160	0.195	0.073	0.670	0.110	0.115	0.092
Milwaukee	0.175	0.206	0.207	0.167	0.189	0.138	0.109	0.072	0.081	0.100

An accident happened to one of the Louisville samples by which the cement was broken from the end so as to allow the acid to enter along the wood and act upon both sides of the cement, and to this is due the excessive softening in this case. There was practically no abrasion of the surface of the cements by the tool where the acids had not come in contact with them, and hence the relative depths to which the tool cut shows the relative resistance of the several varieties of cement to the action of the acids. It will be seen that the Portland cement had softened to the smallest depth, while the Buffalo and Milwaukee had suffered most. It will also be seen that in every case the samples containing the least sand resisted the acid most thoroughly, the mean depths being 0.127 inch where the proportion was 1 of cement to 2 of sand and 0.069 inch where it was 2 of cement to 3 of sand, or only about half as great. It is evident from these results that a rich mortar should be used in the silo and that a coat of pure cement whitewash must afford a marked protection against the acids.

Samples of Adamant and Acme cement have also been tested as to the effect of acetic acid upon them. It was found that both varieties are much more permeable to water than the hydraulic cements are, and that the adamant became very soft in thirty-eight days in a 2 per cent solution of the acid. The Acme cement is acted upon by the acid to some extent, but less than the Portland. On account of its being more permeable to water than the hydraulic cements, I hesitate to recommend its use in silos in their stead, although a practical test may show it superior to them.

Construction of a round silo (pp. 268–274).—Methods of construction of a round silo with and without a roof are described in greater detail than in Bulletin No. 28 of the station.

Rack for silage corn (pp. 274, 275).—A low-down rack used at the station is described and illustrated, and is considered more economical to use than a high one.

Amount of labor required to put corn into the silo (pp. 275–279).—The methods of filling employed at five different silos are described. The observations are summed up in the following table:

Table of comparative amounts of labor required in filling silos.

	Tons per ten hours labor.	Power used.	Kind of corn.	Distance hauled.
No. 1	2.96	Two-horse tread	B & W	Short.
No. 2	2.60	Six-horse sweep	Flint and dent	Long.
No 3	2.43	Engine	B & W	Medium.
No. 4	2.45	Four-horse sweep.	Large dent	Short.
Average	2 6 tons per ten hours with corn cut in.			
One case	2 1 tons per ten hours with corn put in whole.			

The silo and silage in Indiana, C. S. PLUMB (*Indiana Sta. Bul. No. 40, June, 1892, pp. 65–81*).—With a view to increasing the use of silage in Indiana general information is given regarding the construction and cost of silos; the choice, culture, and storing of crops used for silage; and the cost and feeding value of silage. The author estimates that a wooden silo with a capacity of 100 tons can be built under cover in a barn in Indiana for $183, and that the culture and storing of silage will cost about $1.50 per ton. A feeding experiment is briefly reported with eight steers, four being fed on corn silage and four on clover hay, during forty-two days. The animals fed on silage made a larger gain in live weight at less cost, and were sold at a somewhat greater profit than those fed on clover hay. The results of feeding experiments at other stations are briefly summarized, together with reports from a number of persons in Indiana who have been successful in the use of silage. A list of publications on silage is also given.

HORTICULTURE.

A. C. TRUE, *Editor.*

Test of some Japanese beans, C. C. GEORGESON, F. C. BURTIS, and W. SHELTON (*Kansas Sta. Bul. No. 32, Dec., 1891, pp. 233–238*).—"Two species of Japanese beans have been grown here at the station for two years past. These are the soja bean (*Glycine hispida*), and the adzuki—the mungo—of India (*Phaseolus radiatus*). Both of them have given promise of much usefulness in this country. They have been subjected to severe tests concerning their endurance of this climate, and have come out triumphantly."

Notes are given on the growth at the station of eda-mamé, yellow soja bean, yamagata cha-daidzu, kiyusuké daidzu, and the white-podded and black-podded adzuki, with illustrations of 2 varieties of soja beans and the white-podded adzuki, and an analysis of parts of the soja bean plant made in Japan. The 4 varieties of soja beans tested "are early enough to be depended upon to mature seed in this latitude every year; several others have been tried, but rejected because too

late in maturing." The adzuki was found to be "a very good bean for cooking purposes." The following directions are given for raising the plants:

Soja beans.—Do not plant before the ground is warm; in Kansas, from the middle to the end of May. Plant in rows 30 inches (or on low, rich ground, 3 feet) apart, and drop the beans with a drill about 2 inches apart in the row. Keep them free of weeds and give shallow culture whenever the ground begins to form a crust after a rain, but do not work them while the leaves are wet whether from dew or rain. Cut the plants with a scythe or mower when the beans begin to ripen; let them cure in small, high piles, and thresh when dry. If allowed to get too ripe before they are harvested or if left long in the field after they are cut, exposed to alternating showers and sunshine, the pods will burst open and the beans waste.

Adzuki beans should be grown in rows 3 feet apart and the beans dropped about an inch apart in the row and covered 1 inch deep. They should be cut before they are dead ripe, cured in small bunches, and housed as soon as possible. Careful handling is necessary to avoid waste. It was found that the beans are too brittle to be threshed on the machine, nearly all being broken, but they are very easily beaten out with sticks.

A breeding experiment with tomatoes, E. S. GOFF (*Wisconsin Sta. Report for 1891, pp. 152–159, figs. 3*).

Synopsis.—Experiments with Cook Favorite tomatoes grown from seed from mature and immature fruits through six generations indicated that the use of immature seed reduces the growth of the plant, increases its prolificacy, and promotes early maturity.

For six seasons (1883–'89) one strain of Cook Favorite tomatoes has been grown from mature seeds and another strain of the same variety from seeds "taken from fruits that had not commenced to change color toward ripeness."

The foliage and stems of ten plants grown from the ripe seed the past season, from which the fruit had all been picked, weighed on September 21 149 pounds, while the same number from the immature seed weighed but 65½ pounds. These ten plants from the ripe seed had matured up to September 19 1,298 fruits, weighing 57,127.2 grams, while the ten plants from the unripe seed had matured at the same time 2,519 fruits, weighing 102,376.6 grams. * * * The use of immature seed has clearly tended to promote early maturity, though the degree to which this influence has been manifest has not been uniform in different seasons. The first season (1884) the plants from unripe seed matured their first fruit twenty days in advance of those from the ripe seed, and they had matured ten fruits ten days in advance of the latter.* In 1885 the two strains ripened their first fruits on the same day, though the one from unripe seed matured ten fruits seven days in advance of the other.† In 1886 and in 1889 the dates of first maturity were not noted. In 1890 the strain from immature seed ripened its first fruit eight days and 1891 at least fourteen days in advance of the other. Dr. J. C. Arthur, who grew the two strains at the Indiana Station in 1890, secured an earliness of three weeks from the immature seed. It thus appears that in the five trials in which the dates of first maturity were noted the strain from unripe seed gave its first ripe fruit on the average 12.6 days earlier than the other strain.

The size of the fruits has been reduced slightly with the use of immature seed. Thus the fruits from the unripe seed averaged in weight 40.64 grams, while those from the mature fruits averaged 44.01 grams.

*New York State Station Report for 1884, p. 224.

†Ibid, 1885, p. 209.

The firmness of the fruit from the immature seed has been somewhat less than that from the ripe seed, the rind being slightly thinner. A somewhat greater tendency to ripen unevenly has also been manifest, the fruit often being found slightly green at the center when appearing quite ripe externally.

In keeping quality, the fruit from the immature seed has generally been inferior to that from the ripe seed, but the past season this difference scarcely appeared, both strains having kept remarkably well when picked from the plant. The fruit from the immature seed was, however, rather more subject to decay when left on the vines, and has always shown a greater tendency to crack after rain.

The form of the fruit has been very perceptibly affected, being rendered more oblate. Thus in forty typical fruits from the ripe seed measured the past season, the axial diameter was to the transverse diameter as 1 to 1.125, while in the same number from the unripe seed it was as 1 to 1,313. Similar differences were noted in previous years. The number of cells appears to have been affected. The forty typical fruits noted above from the ripe seed contained a total of 97 cells, while those from the unripe seed contained a total of 128 cells. A similar difference was noted by Dr. Arthur in 1890.

The tendency of the fruit to grow double has increased with the use of immature seed. In the yield of ten plants from the mature seed, only 2¼ per cent of the fruit that ripened between August 17 and September 19 were double, while in that of the same number from the immature seed 8 per cent were double. Similar differences have been noted in previous years.

The proportion of seed to the weight of the fruit appears to have been affected. Five typical fruits from mature seed contained 2.64 seeds per gram of fruit, while six typical fruits from the unripe seed contained 3.35 seeds per gram.

The weight of the seed appears to have slightly increased with the use of immature seed. The seeds from the five typical fruits noted above from the plants from ripe seed weighed 2.743 grams per thousand, while those from the six fruits from unripe seed weighed 2.804 grams per thousand. Another sample of seed from the mature seed strain weighed 2.323 grams per thousand, and a second from the unripe seed strain weighed 2.787 grams per thousand. It should be remembered that these seeds were all from mature fruits.

The posture of the plant seems to have been rendered more decumbent by the use of immature seed, a fact noticeable throughout the experiment.

The aspect of the foliage has been affected in a conspicuous manner: The shade of color has been uniformly lighter in the plants from unripe seed and the tendency to blight has been noticeably greater in this strain. The surface of the leaflets has also assumed a much more blistered appearance in the plants from immature seed than in those from ripe seed.

The germinative power of the unripe seed has been uniformly very low. In 1884 seed from a very immature fruit vegetated but 2 per cent, while seed from a ripe fruit in the same trial vegetated 96 per cent. The immature seed planted in the spring of 1891, tested in the Geneva apparatus, showed a germination of 31 per cent, while the ripe seed germinated 99.5 per cent. In three trials the weight of the immature seed was found to be somewhat less than that of mature seed. This was true whether the mature seed came from a plant grown from ripe or unripe seed.

The percentages of water and of ash contained in the plants appear to have been affected, a decrease in the water content, and a corresponding increase of ash having been found in the plants from the unripe seed. * * *

In the fall of 1883 a single plant in a row of the Little Gem tomato, a variety bearing a considerable resemblance to Cook Favorite, was observed to be much more feeble in growth and to have a larger percentage of decayed fruits than any other plant in the row. * * *

In the hope of finding a clew to the cause of this feebleness, seeds were taken from some of the sound fruits from the feeble plant and also from one of the other plants that was apparently in perfect health. The two samples of seeds were planted the

following spring, and the two strains have been continued as in the preceding experiment, with the exception that after the first two seasons the seeds of the feeble strain were taken from decayed instead of from sound fruits. * * *

The feebleness appeared to increase during the first three plantings, but this ash not been true of later plantings. What is more to the present purpose, the changes noted in the preceding experiment as accompanying the use of immature seed have been almost exactly duplicated in this instance.

Sweet corn, thickness of planting, G. W. McCluer (*Illinois Sta. Bul. No. 21, May, 1892, pp. 101, 102*).—Notes and tabulated data on an experiment in which Cory, Burlington, and Roslyn Hybrid were planted in hills in rows 44 inches apart, at distances of from 12 to 36 inches in the row. A bacterial disease materially reduced the crop. In general the yield decreased as the distance between the hills was increased.

Analyses of California prunes, apricots, and peaches, G. E. Colby and H. P. Dyer (*California Bul. No. 97, May 31, 1882, pp. 8*).

Synopsis.—Brief descriptive notes and tabulated proximate analyses of 12 samples of fresh and 1 of dried prunes, 7 of apricots, and 2 of peaches, with ash analyses of French prunes and Royal apricots. The results are discussed in some detail. The work reported in this bulletin is in continuation of that on oranges and lemons recorded in Bulletin No. 93 of the station (E. S. R., vol. III, p. 78).

The varieties included in the samples analyzed were as follows: *Prunes*—Prune d'Agen, French, Wangenheim, Robe de Sergent, Fellenberg, Hungarian, Bulgarian, German, Datte d'Hongrie, and St. Catherine; *apricots*—Hemskirk, Blenheim, Royal, Peach, Moorpark, and Pringle (?); *peaches*—Orange Cling and Lemon Cling.

The general results of the analyses were as follows:

Proximate analyses of prunes, apricots, and peaches.

Analyses.	Peaches. Orange Cling.	Peaches. Lemon Cling.	Prunes.	Apricots.	Dried prunes, Prune d'Agen.
PHYSICAL ANALYSIS.			*Average*	*Average*	
Average weight ... grams	153.50	215.50	27.100	66.100	10.00
Number ... per pound	3.10	2.20	20.500	7.300	48.00
Flesh ... per cent	93.90	93.70	94.550	94.200	90.00
Pits ... do	6.10	6.30	5.450	5.800	10.00
FLESH.					
Juice, pressed ... do	79.10	76.20	73.300	87.300	....
Pulp, pressed ... do	20.90	23.80	26.700	12.700	....
JUICE.					
Total sugar by copper (inversion) ... do	20.00	14.00	16.700	13.340	....
Acid, in terms of sulphuric (SO_3) ... do	0.17	0.32	0.430	0.630	0.62
SUGAR.					47.25
In fresh flesh ... do	16.00	10.80	12.300	11.560	....
In fresh fruit ... do	15.00	10.00	11.650	10.760	....
NITROGEN.					
In whole fresh fruit ... do	....	....	0.148	0.229	....
In fresh flesh ... do	....	....	0.122	0.100	....
In fresh pits ... do	....	....	0.628	0.871	....
Albuminoids in whole fresh fruit (equivalent to nitrogen) ... do	....	....	0.928	1.427	3.00

Proximate analyses of prunes, apricots, and peaches—Continued.

Analyses.	Peaches. Orange Cling.	Peaches. Lemon Cling.	Prunes.	Apricots.	Dried prunes. Prune d'Agen.
ASH (PURE).			*Average*	*Average*	1.65
In whole fresh fruit ... do ..	0.62	0.44	0.403	0.516	.....
In fresh flesh ... do...	....	......	0.395	0.504	....
In fresh pits ... do..	....	....	0.526	0.703	....
GENERAL PROXIMATE ANALYSIS.					
Water ... do...	78.50	86.50	81.290	85.570	28.00
Organic matter ... do ..	20.88	13.06	18.310	13.910	70.35
Ash ... do...	0.62	0.44	0.400	0.520	1.65
Total ...	100.00	100.00	100.000	100.000	100.00

Ash analyses of prunes and apricots.

	French prunes. Whole fruit.	French prunes. Flesh.	French prunes. Pits.	Royal apricots. Whole fruit.	Royal apricots. Flesh.	Royal apricots. Pits.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Pure ash ...	0.442	0.434	0.582	0.550	0.542	0.681
Composition of pure ash:						
Potash ...	65.920	69.500	24.010	54.880	58.890	10.950
Soda ...	3.180	3.070	4.530	10.570	11.200	3.450
Lime ...	3.240	3.010	6.040	3.520	3.240	6.750
Magnesia ...	6.160	5.330	16.260	3.850	3.310	11.580
Peroxide of iron ...	0.850	0.830	1.140	1.710	0.770	12.300
Oxide of maganese ...	0.310	0.170	1.900	0.310	0.090	1.650
Phosporic acid ...	13.190	11.560	32.980	13.860	11.200	43.760
Sulphuric acid ...	2.370	2.130	5.400	2.950	2.750	5.380
Silica ...	4.560	4.300	7.880	7.850	8.310	2.580
Chlorine ...	0.190	0.200	0.220	0.600	0.580	0.650
Total ...	99.970	100.100	100.160	100.000	100.040	100.140
Less excess of oxygen due to chlorine ...	0.050	0.050	0.050	0.150	0.140	0.400
Total ...	99.920	100.050	100.110	99.850	99.900	99.740

Proportion of pits to flesh, prunes.—The range in the percentages of pits is from 3.7 in Hungarian to 7.5 in Robe de Sergent, 5.5 per cent representing the general average, thus leaving about seventeen times as much flesh as pits. * * *

Proportion of pits to flesh, apricots.—Leaving out of consideration the Pringle, on account of its small size and relatively slight importance, the variation of pit percentages is from 4.14 per cent in Hemskirk to 6.7 per cent in Peach. * * * The average pit content is 5.8 per cent, leaving about sixteen times more flesh than pits. * * *

For equal weights of prunes and apricots (whole fresh fruit) the consumer receives nearly the same amount of flesh or available matter. * * *

Proportion of pits to flesh, peaches.—Lemon Cling has some thirty-three times more flesh than pit; Orange Cling shows twenty-five times more flesh.

European analyses of these fruits report figures which do not differ materially from those furnished in the above table; the average pit percentages for prunes is 5.4, for apricots 5.3, and for peaches 6.1, the weights for whole fruits not being given in the analyses at hand.

Proportion of juice to flesh, prunes.—French prune has the largest proportion of free juice, namely, 87 per cent—nearly seven eighths of the flesh. Robe de Sergent falls but slightly below, with 85 per cent, or five sixths of the flesh. The driest flesh is that of St. Catherine (unripe sample), about one half of it being fiber; a later and fully ripe sample of the same name approaches closely the general average of 73 per cent, or nearly three fourths the flesh. It is important to note that Hungarian, while the largest fruit, has nearly 10 per cent less juice than the average French prune, *i. e.*, 70 against 80 per cent.

Proportion of juice to flesh, apricots.—The relation between juice and fiber in the flesh is quite constant, as none of the figures obtained differ more than 5 per cent from the general average (87.3 per cent), the juice amounting to seven eighths of the flesh, Royal, Peach, and Moorpark varieties showing the highest proportion of juice (90 per cent), and Hemskirk (not fully ripe) the lowest (82.3 per cent).

The average flesh of the apricots from this showing is apparently more juicy than that of the prunes, in the ratio of 7 to 6.

Sugar content of the juice, flesh, and fruit, prunes.—By far the highest sugar percentages are found in the ripe, soft, and juicy French prunes of the various localities; the somewhat harder varieties, Wangenheim, Robe de Sergent, Fellenberg, Bulgarian, German, and Datte d' Hongrie, yielding on the average 6 per cent less sugar. Although there is a difference of one month in the picking (September 28 to August 26) of the French prunes from Mountain View and San José, yet for the flesh and fruit the sugar content is nearly identical—18.6 per cent for flesh and 17.6 per cent for the entire fruit, fresh. St. Catherine (ripe) with 22 per cent of sugar in its juice, compares well with the sugar percentage (average 22.6 per cent) in the juice of French prunes; referring these figures to the flesh and fruit, those for the St. Catherine are some 2.5 per cent less on the average. In connection with the St. Catherine it is interesting to note the wide difference, fully 6.5 per cent, in the sugar found in the sample not fully ripe and in that fully ripe, picked over three weeks apart.

Among the other (or firm-fleshed) prunes the widest differences in sugar percentages is 3.8 Datte d' Hongrie showing 12.44 per cent and Wangenheim 8.8 per cent for the whole fruit. A sample of dried French prunes ready for consumption yields 47.25 per cent of sugar. This latter figure is a little over four times larger than the general average of sugar in whole fruit of the fresh prunes.

Sugar content of the juice, flesh, and fruit, apricots.—Both the early (picked in June) and later varieties (picked in August), with the exception of the (not fully ripe) Hemskirk, show a remarkably close resemblance to each other in regard to sugar content, the Royal with 15.06 per cent and Peach with 15.72, the highest in sugar showing but about 2 per cent more than the general average, 13.34 per cent for the juice. Taking the general averages of sugar in the juice of prunes and apricots we find that the prunes stand a trifle over 3 per cent the higher; for the flesh and for the whole fruit the difference is considerably less, viz, about 1 per cent. Apricots then, according to these determinations, range much lower in sugar (6 per cent) than the Prune d'Agen, the difference being nearly the same as already noted above for the harder prunes.

European reports of these fruits show that the juice of prunes contains, on the average, 6.15 per cent sugar, apricots 4.69 per cent (one case is reported of a small variety of apricots with 16.5 per cent sugar), and for peaches 1.48 per cent, these figures being from two and a half to three times less than those herein presented for these fruits as grown in central California. There seems thus to be good cause for the preference they have so quickly attained in the market.

By reference to the small table following the relations to each other of the average sugar and acid contents of some California fruits will readily be seen. For convenience of comparison the acid is expressed in terms of sulphuric acid (SO_3).

	Acid.	Sugar in— Juice.	Sugar in— Flesh.	Sugar in— Whole fruit.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*
Apricots from Niles	0.63	13.34	11.56	10.76
Prunes from Niles, San José, and Mountain View	0.43	16.70	12.30	11.05
French prunes, from Niles, San José, and Mountain View	0.25	22.60	18.33	16.91
Grapes from various localities	0.50	24.00	23.00	20.70
Oranges from various localities	1.34	9.65	6.20	4.70
Peaches from Anderson, Shasta County, and Chico	0.24	17.00	13.40	12.50

Acid in the juice, prunes.—The maximum, nearly 1 per cent, is in the Hungarian; the minimum, 0.23 per cent, in the Prune d'Agen, No. 1; the average, 0.43 per cent, being almost twice the minimum.

Acid in the juice, apricots.—While the acids differ from 0.5 per cent to 0.8 per cent they do not show as great a diversity as the prunes in this respect. In both fruits it appears that low acids are combined with high sugars. European analyses, which report the acid in terms of malic, when corrected for sulphuric, give for prunes 0.51 per cent, apricots 0.7 per cent, and peaches 0.55 per cent, which do not differ much, except for peaches, from those we report.

Nutritive values, nitrogen content.—As heretofore set forth in Bulletin No. 93 [E. S. R., vol. II, p. 78], the California orange with 1.2 per cent albuminoids, while lower in these ingredients than the Sicilian (1.73 per cent albuminoids), was rated the first in this respect among our fruits. In so far as our later work bears in this direction we must accord to the apricot (edible portion alone) an equal place, albuminoids being 1.19 per cent; the prune (0.76 per cent albuminoids) takes the second place; leaving the other fruits, grapes, bananas, apples, and pears (from European data), to stand in the order now mentioned till we find opportunity to study them. The apricot as a whole (pits included) shows 1.43 per cent albuminoids or 0.23 per cent more than the orange.

Among the prunes the highest percentages of albuminoids (0.94) is found in the flesh of German and the ripe St. Catherine, closely followed by that of the Prune d'Agen with 0.86 per cent; the lowest of the series being the Robe de Sergent, with only 0.52 per cent—about 0.2 per cent less than the average for the flesh of all the prunes, which is 0.76 per cent.

The flesh of the apricots shows even a greater difference in albuminoids than the flesh of the prunes, being quite one half of 1 per cent; the maximum, 1.37 per cent albuminoids, is seen in the Royal and the Moorpark; the minimum, 0.84 per cent, in the Peach variety, ranges nearly with the highest albuminoid content in the prunes, 0.94 per cent.

Apricots grown in Europe average 0.49 per cent albuminoids, just about one third as much as the Californian (1.37). European prunes (with 0.78 per cent albuminoids), however, are more nearly like the Californian (0.76 per cent) in this respect.

With this portion of our work we give below a summary of the food constituents of some of our dried (cured) commercial French prunes, dried apricots, and grapes:

	Dried edible portion of—			
	French prunes.	Apricots.	Grapes, Black Malvasia, "Grape Food."*	Apples (European).
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Water	25.20	32.44	34.83	33.00
Ash	1.50	1.38	1.16	1.40
Albuminoids (crude protein)	2.70	3.27	2.94	1.70
Crude fiber	....	....	3.70	8.30
Nitrogen-free extract	29.67	31.81	2.17	21.60
Fat	....	....	0.56	....
Sugar	40.53	29.59	52.50	32.00
Free acid, calculated as sulphuric (SO_3)	0.40	1.51	0.85	2.00
Tannin	....	....	1.29	....
Total	100.00	100.00	100.00	100.00

* Dried and ground by R. E. Wood, Rutherford, Napa County, California.

Ash composition and nitrogen content.—Contrary to statements in our previous publications (Bulletins Nos. 88 and 93), in which, according to European data, the orange stands second (grapes being first) among fruits in the quantity of mineral matter withdrawn from the soil, we find that weight for weight the apricot has the second

place, and that the prune and the orange have about an equal right to the third place, thus again bringing plainly before us the fact that we can not safely use European results, as heretofore, as a basis of comparison for our fruits.

Upon the basis of the preceding table of this publication and those given in Bulletin No. 93, we have prepared the following tabular view of the amounts, in pounds, of soil ingredients extracted by the different fruit crops, that will have to be replaced by fertilization:

Fruits.	Total ash.	Potash.	Phosphoric acid.	Nitrogen.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
GRAPES.				
European:				
In each 1,000 pounds	8.8	5.00	1.52	1.70
APRICOTS.				
European:				
In each 1,000 pounds	4.90	....	....	0.86
Crop of 30,000 pounds	147.00	....	....	25.80
California:				
In each 1,000 pounds	5.16	2.16	0.71	2.29
Crop of 30,000 pounds	154 80	84.98	21.38	68.70
PRUNES.				
European:				
In each 1,000 pounds	6.3	3.73	0.95	1.22
Crop of 30,000 pounds	189.00	111.90	28.53	36.60
California:				
In each 1,000 pounds	4.03	2.653	0.53	1.48
Crop of 30,000 pounds	120.90	79.700	15.95	44.40
ORANGES				
European:				
In each 1,000 pounds	6.07	2.78	0 67	2.69
Crop of 20,000 pounds	121.40	55.60	13.40	53.80
California:				
In each 1,000 pounds	4.32	2.11	0.53	1.83
Crop of 20,000 pounds	86.40	42.20	10.60	36.60

California prunes thus appear to draw much less upon all the mineral ingredients which have to be replaced by fertilization than the European; the latter, however, draw much more lightly than the former upon nitrogen. Apricots, both of Californian and European growth, stand, in total amount, about equal as to mineral ingredients withdrawn; as to nitrogen, the California fruit draws 2.5 times as much, showing the very material difference in the relative proportions of the vital silo ingredients among themselves.

Potash.—In the ashes of prunes and apricots, as in the orange, potash is seen to be the leading ingredient (at least one half the ash), ranging somewhat higher in the two former fruits. In its distribution as between pits and flesh the greatest difference is shown by the European prune. For apricots we have no foreign data. Although potash constitutes so large a portion of the ash of these fruits, its replenishment to the soil will be delayed long beyond the addition of other fertilizing ingredients because most California soils are naturally so well stocked with it that available potash for the current demand will in many cases be adequately supplied for many years.

Phosphoric acid is not so heavily drawn upon, nor do our fruits in any case so far quite reach the same demand upon the soil in this respect as the European. Its distribution between pits and flesh also is not quite so variable as that of potash. Since our soils usually contain a limited supply of phosphoric acid, the prune and apricot, as well as the orange orchards, will require phosphatic fertilizers first when any are used.

Nitrogen.—The apricot here leads in its demand upon the soil in this substance, closely following the European orange. Averaging the nitrogen withdrawn by the

prune and apricot, we obtain a figure but slightly greater than that for the orange, emphasizing for those fruits the same necessity of early replacement of nitrogen, and partly for the same reason, viz, that California soils are usually not rich in their natural supply of this substance.

Of the other ash ingredients it will be seen that lime is quite constant, although much less in amount (for prunes) than European standards show. Especially is this difference seen in the comparison of the ash analyses of the flesh and pits. In the orange ash the lime content far exceeds that of either the prune or apricot; accordingly as our soils generally contain plenty of lime even for oranges, we would rarely expect to fertilize with a view to its replacement. Soda is seen to be much higher here than in European analyses of the ash of the prune; this is probably explained by the fact that California soils, like those of other arid regions, contain much more soda than the European.

The cultivated native plums and cherries, L. H. BAILEY (*New York Cornell Sta. Bul. No. 38, June, 1892, pp. 73, figs. 11*).

Synopsis.—Classified descriptions of 140 named varieties, with statements regarding important varieties, methods of propagation, and insects and fungous diseases attacking plums. Tabulated data are given regarding the home and market value, date of ripening, and period of blooming of a number of these varieties. There are also descriptions of 8 species of native cherries, special attention being given to the sand and dwarf cherries.

The classification of native plums adopted in the bulletin is as follows:

Americana group (*Prunus americana*).—American Eagle, Beaty Choice, Black Hawk, Brainerd, Cheney, Chippeway, Cottrell, Deep Creek, De Soto, Forest Garden, Gaylord, Harrison Peach, Hawkeye, Ida, Illinois Ironclad, Iona, Itaska, Kickapoo, Kopp, Late Rollingstone, Le Duc, Little Seedling, Louisa, Luedloff Green, Luedloff Red, Maquoketa, Minnetonka, Mussey, Newtown Egg, New Ulm, Ocheeda, Peffer Premium, Purple Yosemite, Quaker, Rollingstone, Speer, Van Buren, Wazata, Weaver, Wier Large Red, Wild Rose, Wolf, Wyant, Yellow Sweet, Yellow Yosemite.

Wild Goose group (*Prunus hortulana*).—Clark, Cumberland, Garfield, Golden Beauty, Honey Drop, Indian Chief, Kanawha, Missouri Apricot, Moreman, Poole, Reed, Roulette, Sucker State, Texas Bell, Wayland, Whitaker, Wild Goose, World Beater.

Miner group (*Prunus hortulana*, var. *mineri*).—Clinton, Forest Rose, Idol, Indiana Red, Iris, Langsdon, Leptune, Miner (Parsons), Prairie Flower, Rachel.

Chickasaw group (*Prunus angustifolia*).—African, Arkansas Lombard, Caddo Chief, Coletta, Early Red, El Paso, Emerson Early, Hoffman, Jennie Lucas, Lone Star, Newman, Ogeechee, Pottawattamie, Robinson, Schley, Strawberry, Wooten, Yellow Transparent.

Marianna group.—De Caradeuc, Marianna, Hattie.

Beach plum (*Prunus maritima*).—Bassett American.

Prunus subcordata.

Hybrids.—Blackman.

Unclassified varieties.—Allen Yellow, Berry, Champion, Charles

Downing, Cherokee, Col. Wilder, Cook Choice, Couler, Crescent City, Diamond, Dr. Dennis, Dunlap, Early Honey, Ellis, Esther, Excelsior, Hammer, Houston County, Hughes, Iola, Irene, Ithaca, James Vick, Jewell, Jones, Miles, Milton, Mrs. Clifford, Muncy, Munson, New American, Okaw, Piram, Rare Ripe, Raymond, Rockford, Rocky Mountain Seedling, Round, Silas Wilson, Smiley, Tenneha, Tomlingson, Van Deman, Wady Early, Winnebago.

The following summary is taken from the bulletin:

Plums.—(1) The native plum industry dates from the dissemination of the Wild Goose some forty years ago. It is only within the last decade, however, that this industry has assumed great importance.

(2) Five species and one botanical variety of native plums are now in cultivation for their fruits.

(3) Nearly all the commercial varieties belong to three species, *Prunus americana*, *P. hortulana*, and *P. angustifolia*. These species grow wild in regions east of the Rocky Mountains.

(4) *Prunus americana* grows the farthest north of any of the native plums, and its varieties are the hardiest of any. The species also grows as far south as northern Mexico. The range of adaptability of its varieties may therefore be assumed to be very great. The species is naturally variable and is therefore attractive to the horticulturist.

(5) The fruit of *Prunus americana* is firm and meaty, usually somewhat compressed or flattened, often marked by a distinct suture, dull in color, which ranges through various shades of red and purple to an ill-defined and blotched orange. The skin is thick and tough, often acerb, and covered with a pruinose bloom. The stone is large and more or less flattened and winged, and is sometimes nearly or quite free, and the surface is either slightly pitted or perfectly smooth.

(6) Forty-five varieties are referred to *Prunus americana* in the preceding lists. The most popular of these are Cheney, Deep Creek, De Soto, Forest Garden, Itaska, Louisa, Purple Yosemite, Quaker, Rollingstone, Weaver, and Wolf. The Americana varieties succeed best, on the whole, in the Northern States of the Mississippi Valley, as in Wisconsin, Iowa, and Minnesota; some of them, however, are successfully grown in Texas and on the Atlantic Slope so far south as 37° or 38°.

(7) *Prunus hortulana* grows wild in the Mississippi Valley from northern Illinois to Arkansas, extending eastward into Kentucky and Tennessee and possibly farther, and in the Southwest spreading over a large area of Texas. It is naturally variable and has given many important cultivated varieties. It has never been recognized as a distinct species until this year. There are two or three distinct types represented in the species, one of which, the Miner group, appears to possess some radical points of difference from the typical representatives of the species.

(8) The fruit of *Prunus hortulana* is firm and juicy, spherical or spherical-oblong, never flattened, and in color ranges through several shades of bright red to clear pure yellow. The skin is thin, often marked with small dots, and is usually covered with a thin bloom. The stone always clings; it is comparatively small, rough, turgid, sometimes prolonged at the ends, but is never prominently wing-margined.

(9) The Wild Goose is the best known of the native plums, although its quality is not high. This popularity is due to its productiveness, earliness, beauty, good shipping qualities, and to the circumstance that it was early introduced to cultivation. This variety is grown from Iowa, Michigan, and New York to Georgia and Texas.

(10) The Wild Goose group of plums as a whole is well suited to the middle latitudes. The most prominent members of the group are Golden Beauty, Indian Chief, Missouri Apricot, Moreman, Wayland, and Wild Goose.

(11) The Miner group differs from the Wild Goose or true Hortulana group by dull

and comparatively thick leaves, which are conspicuously veiny below and irregularly coarse-toothed and more or less obovate in outline, and by a rather late and very firm fruit and a flat and nearly or quite smooth stone. The varieties are all much alike. In a wild state this form of native plum probably grows from Illinois to Tennessee and Arkansas.

(12) Ten varieties are referred to the Miner group, of which the most prominent is the Miner. This variety was the first native plum to receive a name from horticulturists. Its history runs back to 1814. Seventy years ago it was known as Old Hickory and General Jackson. Next to the Wild Goose the Miner is the best known of the native plums. It is hardy in northern Illinois and is popular in the Central and some of the Southern States.

(13) The Chickasaw plums are characterized by slender, spreading, and zigzag growth, comparatively small lanceolate or oblong-lanceolate conduplicate (or trough-like) leaves, which are shining and closely and finely serrate, and by an early red or yellow, soft, stringy-fleshed fruit, which is more or less dotted, and a clinging, broad, roughish stone. In a wild state the Chickasaw plum is usually thorny and the thorns persist in a few cultivated varieties. The species grows wild from southern Delaware to Florida and westward to Kansas and Texas.

(14) The most important varieties of Chickasaw plums are Caddo Chief, Jennie Lucas, Lone Star, Newman, Pottawattamie, Robinson, and Yellow Transparent. The Newman is the most generally known and this is hardy in central New York. The Chickasaws are best adapted to the Central and Southern States. Many of them are not hardy in Michigan and New York.

(15) The Marianna and DeCaradeuc constitute a distinct class or group of plums, and the Hattie is evidently allied to them. They are to be associated with the Myrobalan plum. DeCaradeuc is probably Myrobalan, and Marianna appears to be a hybrid. The history of the Myrobalan is obscure, but it is clearly of Old World origin. It is largely used as a stock, but there are varieties grown for fruit.

(16) The Marianna has assumed great importance because of its use as a stock for many plums and allied fruits. Its merits are the ease with which it grows from cuttings, and the facility with which it unites with other species.

(17) The beach plum or *Prunus maritima*, of the Atlantic coast, is in cultivation both for ornament and for fruit. As a fruit plant it is represented only in Bassett's American, a fruit of little value.

(18) The Pacific wild plum (*Prunus subcordata*) was introduced to cultivation in 1889 as a possible fruit plant, but its merits are not yet determined.

(19) Hybrids appear to occur between the Wild Goose and the peach. J. W. Kerr of Maryland has produced such a hybrid, and the so-called Blackman plum appears to be another.

(20) Some varieties of native plums, notably Wild Goose and Miner, are not fertile with themselves, and this fact has undoubtedly retarded the progress of native plum culture. This infertility is due to comparative impotency of pollen upon flowers of the same variety rather than to any structural imperfection in themselves.

(21) This infertility is avoided by mixed planting, by means of which foreign pollen is supplied to the impotent varieties. Care should be taken to associate varieties which bloom at the same time, and with this precaution the ordinary mixed or alternate planting, at usual distances, appears to be successful.

(22) The best stocks for native plums are probably seedlings of the same species, although they grow well as a rule upon related species and even upon the peach in some instances. Perhaps the most popular stock at present is the Marianna, because of its habit of growing readily from cuttings, and so far it appears to have given satisfaction. The Chickasaw and Hortulana types succeed well upon the peach. Chickasaw stocks sprout so badly that they are in disfavor. In the North, Americana stocks are popular for all the varieties which succeed there.

(23) As to the best varieties there is great difference of opinion. In the northernmost States the Americana class is most reliable, although some of the Hortulanas

succeed. For the South the Chickasaws are numerous and popular. The Hortulanas occupy an intermediate position.

(24) The native plums are in most regions comparatively free from insect abuses. Although there are no curculio-proof plums, the curculio does less damage to the native varieties than to the common or Domestica types.

(25) Among diseases a mysterious blight and the peach rosette are prominent in the South. A fruit scab and fruit spot also occur. The septoria or shot-hole fungus, which causes the serious shedding of leaves in the Domestica plums, does little damage upon the natives. The black knot, brown fruit rot, and plum pockets are other diseases which the grower will be likely to meet.

(26) As a whole, the native plum industry has made astonishing progress and it has already assumed large proportions. It is certain to occupy a large place in future American horticulture.

Cherries.—(27) Eight and perhaps ten species of native cherries are in cultivation. Of these, three are grown for fruit, and all but one or two are cultivated for ornament. None of the species, however, have gained much prominence under cultivation. Most of them are of comparatively recent introduction.

(28) The so-called dwarf or sand cherries are much confused, two, and perhaps three species are passing as *Prunus pumila*. (*a*) The true *P. pumila* or sand cherry is a low straggling shrub, growing along rivers and coasts from Maine to Pennsylvania and Manitoba. It has long, thick leaves and produces cherries of variable size, color, and quality. Some of these varieties give great promise as garden fruits, and they are already under test at experiment stations. The plant is also being tested as a stock for dwarf cherries. (*b*) *P. cuneata* is a slender, upright shrub with larger flowers and shorter obtuse spatulate or obovate thin leaves, growing in cooler lands from New England to North Carolina and Minnesota. It is in cultivation as an ornamental plant under the name of *P. pumila*. (*c*) The representative of *P. pùmila* upon the plains of Nebraska and in the Rocky Mountains is a very low plant, with short, thick leaves, and large, short-stemmed fruit, the botanical position of which is yet unknown. It is now in cultivation as the Improved Dwarf Rocky Mountain cherry.

(29) The Utah Hybrid cherry is a fruit of uncertain value and doubtful affinity. Two varieties, the black and red, are in cultivation. It probably comes from some part of the Western plains or the Rocky Mountain region, but its wild prototype is not known.

(30) Other native cherries in cultivation are, *Prunus serotina*, the wild black cherry; *P. pennsylvanica*, the bird, pin, or wild red cherry; *P. virginiana*, the choke cherry; *P. demissa*, the Western choke cherry; *P. ilicifolia*, the Islay of the Pacific Slope; *P. caroliniana*, the cherry laurel or mock orange of the Southern States.

Test of varieties of strawberries and raspberries, E. S. Goff (*Wisconsin Sta. Report for 1891, pp. 142–151, figs. 7*).—Brief descriptive notes on a number of varieties of strawberries and raspberries, with illustrations of the following varieties of strawberries: Warfield No. 2, Haverland, Eureka, Gandy, Van Deman, and Bubach No. 5. Warfield No. 2 was the most productive variety and had a longer bearing season than any other except Van Deman. Eureka was the latest variety. Edgar Queen was decidedly productive, the fruit resembling that of Sharpless in size and quality. Shuster Gem and General Putnam were relatively inferior, and Monmouth, Clingto, Clara, and Governor Hoard were failures.

Descriptive notes are given on the following varieties of raspberries which came into bearing at the station in 1890: Thompson Early Prolific, Thompson Early Pride, Muskingum, and Gladstone.

Horticultural notes, T. J. BURRILL and G. W. MCCLUER (*Illinois Sta. Bul. No. 21, May, 1892, pp. 73–81*).—A general report of progress in the horticultural work of the station.

Test of varieties.—"We have growing on our grounds at present 475 varieties of apples, 28 of pears, 40 of plums, 48 of cherries, 8 of peaches, 15 of apricots, 2 of quinces, 6 of gooseberries, 7 of currants, 120 of grapes, 14 of blackberries, 30 of red and black raspberries, and 98 of strawberries."

The following are especially recommended: *Apples*—for market, Ned and Early Ripe; for family use, Jefferis, Higby Sweet, and Sharp. *Grapes*—Concord, Worden, Moore Diamond, Brighton, and Massasoit; for long keeping, Vergennes, Goethe, and Duchess. *Blackberries*—Snyder. *Black raspberries*—Palmer. *Red raspberries*—Turner, Marlboro, Cuthbert, Clarke, and Schaffer Colossal.

Winter protection of peach trees.—Experiments in turning down the trees and covering them with evergreen branches, cornstalks, or coarse straw, have given fairly favorable results.

The varieties of peaches differ in hardiness. During the past winter the temperature fell to —12½° F. at one time and to —15° F. at another. An examination of the buds of 6 different varieties gave the following results:

Variety of peach.	No. of buds examined.	No. of buds dead.	No. of buds alive.	Per cent of buds alive.
Alexander	121	79	42	34
Lemon Cling	151	133	18	13
Roser	144	24	120	83
Thurber	192	62	130	67
Wager	172	157	15	8
Seedling Cling	766	170	596	77

Whole and piece root grafting.—"A study of whole and piece root grafting has been begun. For this purpose something more than 2,000 grafts were put up here and were set last spring, though many of them failed to grow."

We have used roots in the following forms:

Roots 10 inches long with the scion set 2 inches above the collar, on the collar, and 2 inches below the collar.

Roots cut into two pieces each 5 inches long, being careful to put the scion in the collar of the upper cut.

Roots cut and scions put in the same as the last, but leaving the side branches on the root.

Roots cut into three pieces each 4 inches long, again putting the scion on the collar of the upper cut.

In like manner the roots were cut into bits 2 inches and 1 inch long.

The conclusions from one year's work are:

The whole root has no advantage over a piece root of the same size (size refers to both length and thickness).

Roots with the small side branches left on gave better results than roots of the same size with the rootlets cut away.

Roots 5 inches long gave better results than roots 4 inches, 2 inches, or 1 inch long.

Roots 5 inches long not trimmed gave nearly as good results as roots 10 inches long.

WEEDS.

Troublesome members of the mustard family, C. B. WALDRON (*North Dakota Sta. Bul. No. 6, June, 1892, pp. 19, figs. 7*).—Illustrated popular descriptions of wild mustard (*Brassica sinapistrum*), tansy (*Sisymbrium canescens*), treacle mustard (*Erysimum asperum*), wormseed mustard (*Erysimum cheiranthoides*), false flax (*Camelina sativa*), shepherd's purse (*Capsella bursa-pastoris*), penny cress (*Thlaspi arvense*), and pepper grass (*Lepidium intermedium*). The necessity of great carefulness in sowing only pure seed of cultivated plants is urged. In some cases hand-pulling of weeds has been found profitable. If necessary, plowing the crop under with the weeds should be resorted to. Summer fallowing and plowing fallow during July and August are likely to spread these weeds.

Weeds of West Virginia, C. F. MILLSPAUGH (*West Virginia Sta. Bul. No. 23, May, 1892, pp. 215–310, figs. 66*).—Brief descriptions of 20 species of weeds, with suggestions as to means for their eradication. The weeds described are classified as follows:

	Worst.	Bad.	Indifferent.	Total.
Perennial	42	45	38	125
Biennial	13	6	1	20
Annual	27	17	11	55
Total	82	68	50	200

DISEASES OF PLANTS.

A few common diseases of crops and their treatment, F. D. CHESTER (*Delaware Sta. Bul. No. 15, Jan., 1892, pp. 16*).

Synopsis.—Accounts of experiments with fungicides for diseases of grapes, pear leaf blight, and peach rot; notes on diseases of potatoes; and formulas for various fungicides. During three years Bordeaux mixture has been found an effective and cheap fungicide for black rot of grapes. Other copper compounds were successfully used on grapes in 1891. Several copper compounds have proved effective for pear leaf blight. A copper and ammonium carbonate mixture was successfully used for peach rot.

Experiments on grapes.—A summary is given of experiments in 1889 and 1890 at Smyrna, Delaware, with Bordeaux mixture for black rot of grapes. Detailed accounts of these experiments were given in Bulletins Nos. 6 and 10 of the station (E. S. R., vol. I, p. 195, and II, p. 713).

In 1888 the black rot held complete possession of Mr. Anthony's vineyard, and as a consequence he obtained from 1,200 vines less than 250 pounds of fruit, his loss that year being approximately 98 per cent of a normal crop. In 1889 the vineyard was treated with the Bordeaux mixture. The season was an especially wet one and

every condition favorable to the disease prevailed. Notwithstanding this, 1,088 sprayed vines yielded 2,953 pounds of sound fruit, or 2.71 pounds per vine as compared with 0.28 pound per vine the year previous. Although this represented but about one fourth of a normal crop, the low yield is not all to be charged to the rot, but partly to an unfavorable season and partly to the diminished vitality of the vines, owing to the prevalence of disease during previous years.

In 1890 the vineyard was treated for the second year, and as a result 879 sprayed vines yielded 7,451 pounds of sound fruit, or 8.47 pounds per vine, as compared with 2.71 pounds per vine the previous year, while an actual count showed but one half of 1 per cent of decayed fruit.

In 1891 the vineyard was treated for the third year, and at harvest yielded 16,000 pounds of sound fruit from 1,200 vines, or 13.3 pounds per vine. An actual count made by Mr. Anthony just before harvest revealed but five decayed berries in the entire vineyard.

The average cost of applying Bordeaux mixture five times each season at the rate of one fourth gallon per vine at each application, has been 2.77 cents per vine.

Notes and tabulated data are given for an experiment in the vicinity of the station in which copper carbonate in suspension, copper soda hyposulphite, Johnson's mixture (copper sulphate and ammonium carbonate), and a copper and ammonium carbonate mixture (copper carbonate 8 ounces, ammonium carbonate 1 pound, water 25 gallons) were each applied to grapevines five times during the season of 1891. The average percentages of decayed fruits on the treated vines were 0.85, 1.56, and 1.96 for the respective mixtures, as compared with about 40 per cent on the untreated vines. Johnson's mixture and the copper soda hyposulphite have a tendency to injure foliage.

Experiment on pears.—In Bulletin No. 13 of the station (E. S. R., vol. III, p. 144) an account is given of experiments with various fungicides for pear leaf blight (*Entomosporium maculatum*). These tests were repeated in 1891 on twelve pear trees. The results for the two years are summed up in the following table:

Results of experiments with fungicides for pear leaf blight.

Fungicides.	Action on foliage and fruit.	Value in treatment of leaf blight.	Remarks.
(A) Ammoniacal solution of copper carbonate.	A tendency to injure foliage and roughen the fruit.	Effective	
(B) Copper and ammonium carbonate mixture (original form).	Little or no action on foliage or fruit.	Equal in effectiveness to (A).	Preferable to (A.)
(C) Copper carbonate in suspension.	No action on fruit or foliage.	Effective	
(D) Bordeaux mixture	do	Very effective	Expensive and troublesome when used for leaf blight alone.
(E) Modified eau celeste.	But slight action on foliage.	do	High per cent of perfect fruit in 1890. Can be used one half strength for leaf blight alone.
(G) Copper soda hyposulphite.	Little or no action on foliage or fruit.	Effective	Nothing special to recommend it.
(H) Johnson's mixture	Injured foliage and fruit	Should not be used.	
(I) Copper and ammonium carbonate mixture (later form).	Little or no action on foliage or fruit.	Very effective	

Experiment on peaches.—In 1891 the copper and ammonium carbonate mixture was used for peach rot on ten trees on a farm near Seaford, Delaware. The applications were made four times between June 3 and July 3. At harvest 89 per cent of the fruit on the treated trees was sound while unsprayed trees did not yield a single sound peach. An attempt was made to apply Bordeaux mixture, but the injury to foliage from this mixture was so great that its use was discontinued.

Diseases of the potato.—Description of potato rot (*Phytophthora infestans*), a bacterial disease, and leaf blight (*Macrosporium solani*), with suggestions regarding treatment.

Fungicides.—Formulas for the fungicides used in the experiments recorded in the bulletin.

Treatment of some fungous diseases of fruits, L. H. PAMMEL (*Iowa Sta. Bul. No. 17, May, 1892, pp. 419–443, plates 5, figs. 2*).

Synopsis.—A report on successful experiments in 1891 with ammoniacal carbonate of copper and Bordeaux mixture separately, for powdery mildew and spot diseases of currants and cherries and leaf blight of the pear.

The ammoniacal carbonate of copper was prepared by adding 3 ounces of copper carbonate to 1 quart of ammonia (sp. gr. 26) and diluting with 22 gallons of water.

The Bordeaux mixture was prepared as follows: "Twelve pounds of copper sulphate dissolved in 20 gallons of water. The copper sulphate was broken up. The water was allowed to act usually from twelve to twenty-four hours, by which time most of the copper sulphate had dissolved. In another vessel slacked lime was prepared by using 8 pounds of lime to 12 gallons of water. The lime and copper sulphate solutions were then poured together and enough water added to make 50 gallons." No injury to foliage resulted from the use of these fungicides.

Currants.—White Dutch currants sprayed with the Bordeaux mixture June 9 and 26 and July 3 lost many of their leaves during the latter part of August, but were in better condition than unsprayed bushes. Seven applications of the ammoniacal carbonate of copper between June 6 and August 13 gave decidedly favorable results, though frequent rains fell during the period of spraying. On Black Naples currants the results of spraying with ammoniacal carbonate of copper were not so marked.

Cherries.—Ammoniacal carbonate of copper was applied to Mahaleb seedlings budded with a Russian variety ten times between June 6 and August 4. Tabulated data taken August 12 show that the average height of thirty-five each of the treated and untreated plants was 26.6 and 25.3 inches respectively, number of leaves 128.5 and 62.5. Powdery mildew was entirely absent from the treated plants, but very abundant on the untreated.

Bordeaux mixture was applied to Russian seedlings and Mahaleb seedlings budded with Russian varieties seven times between June 10

and August 6. Tabulated data taken August 27 show that the average height of thirty-five each of the treated and untreated plants was 6 and 4 inches respectively, number of leaves 15 and 6, number of branches 1.3 and 0.5. There were fewer spotted leaves, but as regards powdery mildew the difference was not so marked as in the experiment with ammoniacal carbonate of copper.

Bordeaux mixture was also applied to budded cherries of the varieties King Morello, Griotte du Norde, and Sklanka five times between June 13 and July 2. Tabulated data taken July 13 show that the average height of thirty each of the treated and untreated plants was 29.8 and 25.7 inches respectively, number of branches 7.3 and 6.7, number of leaves 102 and 53. Many of the untreated leaves were yellow and spotted. Powdery mildew was checked on the treated plants.

Pears.—Ammoniacal carbonate of copper was applied to pear trees for leaf blight eight times between July 8 and August 1. Tabulated data show that the average height of twenty-five each of the treated and untreated trees was 39.2 and 38.5 respectively, number of branches 10 and 6.4, number of leaves 258 and 53.

Treatment of potato blight with Bordeaux mixture, E. S. GOFF (*Wisconsin Sta. Report for 1891, pp. 138-141*).—A report on experiments carried on by the station in coöperation with this Department and previously recorded in the Journal of Mycology, vol. VII, p. 23, and in the Report of the Secretary of Agriculture for 1890, p. 400. The increased yield from the use of the fungicide more than repaid the cost of the treatment. The best yields were obtained when the Bordeaux mixture was used in its full strength.

Experiment in the treatment of apple scab, E. S. GOFF (*Wisconsin Sta. Report for 1891, pp. 160, 161*).—A summary of experiments carried on by the station in coöperation with this Department, in which copper carbonate dissolved in ammonia, "sulphur powder," and a compound of copper sulphate and ammonium carbonate were used in the treatment of apple scab. A detailed report of these experiments was published in the Journal of Mycology, vol. VII, p. 17. The ammoniacal solution of carbonate of copper was most satisfactory, and the best results were secured when the spraying was commenced before blooming.

ENTOMOLOGY.

Entomological notes, I. H. ORCUTT and J. M. ALDRICH (*South Dakota Sta. Bul. No. 30, March, 1892, pp. 20, figs. 2*).—The insectary recently constructed at the station is briefly described.

"About the middle of May, 1891, an examination was made of 748 cocoons of *Cimbex americana*, the large willow sawfly, for the purpose of ascertaining the proportion that were parasitized. The results were

as follows: 375 cocoons, or 50 per cent, contained healthy larvæ or pupæ; 229, or 31 per cent, contained cocoons of a large parasite, *Opheltes glaucopterus*, Linn.; 25, or 3 per cent, contained several cocoons each of smaller hymenopterous parasites; 23, or 3 per cent, contained dipterous parasites; 96, or 13 per cent, contained larvæ dead but not parasitized." Descriptive notes are given on the following species reared from this collection: *Opheltes glaucopterus*, *Cryptus nuncius*, *Limneria ferrugineipes*, *Mesochorus melleus*, and *Sarcophaga cimbicis*, n. sp.

An examination of the stomachs of 15 striped gophers resulted in the finding of "19 or 20 cutworms, 11 other lepidopterous larvæ, 3 grasshoppers, and 2 crickets, all of which may be set down as injurious. The number of beetles of all kinds could not be definitely ascertained, but was 30 to 35. None of them were species which are noted either for benefiting or injuring the farmer." The stomachs also contained corn, grass, grain, etc.

A cheap device for applying insecticides to potatoes in the field is described and illustrated.

It is in a degree a modification of the common street sprinkler, the delivery being arranged so that the liquid falls only on the rows. The hind wheels and axle of a wagon were taken to begin with; a tongue was added and a platform for a barrel was built over the axle; underneath the barrel a connection was made with a long transverse delivery pipe, which was located behind the wheels, resting on iron supports running back from the corners of the platform. This pipe carried three backward-directed nozzles, at the same distance apart as the rows of potatoes (3½ feet). The sprinklers are the size used on small sprinkling pots and were obtained at a hardware store. Aside from the wheels and axle the entire cost of material was about $5.

An account is given of an unsuccessful attempt at wintering bees at the station. It was found that the bees did not obtain much honey from the native wild flowers. So little honey was stored that it was necessary to feed the bees during the winter.

Soap suds were successfully used for lice on cabbages, and kerosene emulsion for lice on live stock and scab on sheep.

Work in economic entomology, E. S. GOFF (*Wisconsin Sta. Report for 1891, pp. 162–175, figs. 6*).

Synopsis.—A report on (1) a new method of applying kerosene for insects; (2) trapping and poisoning cutworms; (3) prevention of the ravages of the cabbage maggot by means of tarred paper placed around the stem of the plant; and (4) experiments in spraying for the aphis with kerosene.

A new method of applying kerosene for insects.—During three seasons satisfactory results have been obtained by applying kerosene as follows: "The method is very simple and consists in so constructing the lower valve seat of a pump that it allows the entrance of water through one opening and kerosene through another. The two liquids become mixed in passing through the valves and cylinder of the pump, and are finally broken up into an exceedingly fine spray by being forced through a good spraying nozzle."

The pump used, with its kerosene attachment, is illustrated.

The mechanical mixture secured with this apparatus, while not absolutely permanent, has been found upon repeated experiments sufficiently slow of separation for safe use upon plants. When the spray is collected in a glass vessel the liquid appears milky white. The kerosene rises at a rate proportionate to its amount, but the mixture retains its milky appearance for hours. * * *

The mechanical mixture of kerosene and water, as produced by the modified pump here described, was tested upon the foliage of arbor vitæ, Norway spruce, peony, rose, sweet William, oat, strawberry, apple, mountain ash, grape, raspberry, blackberry, plum, moonflower (*Ipomœa*), and Chapman honey plant (*Echinops sphærocephalus*). In no case did it prove injurious, unless the amount of kerosene exceeded 10 per cent, and in many cases it was quite harmless when used in much stronger proportion. The grade of kerosene used in every case was the common "headlight" illuminating oil.

Many other tests of the apparatus were made the past season, with the result that kerosene applied in this manner proved equally efficient as a destroyer of insects with the soap emulsion and no more injurious to foliage. It is more penetrating than the soap emulsion and is more satisfactory to use as it passes through the pump much more readily.

Pumps intended for spraying kerosene in this manner should not have rubber packings as the oil acts rapidly upon rubber. It did not appear to affect the hose, but the rubber piston of the pump used was soon destroyed. A leather piston substituted for the rubber proved satisfactory and durable. The same applies to the kerosene emulsion.

It was also found that bisulphide of carbon sprayed with water through this attachment makes a mixture that is sufficiently permanent for practical purposes.

Notes on cutworms.—In the spring of 1890 and 1891 experiments were made in trapping cutworms beneath piles of poisoned clover, rye, grass, and prickly comfrey. Many worms were secured, but the poison (Paris green) did not destroy them in any considerable number. In one case it appears that out of six hundred and forty-six cutworms which had been some hours beneath the poisoned clover piles, not more than one hundred and forty-six were killed by the poison. A record of the number of cutworms trapped during a fortnight (May 20 to June 5) indicated that the number of cutworms in the soil may be reduced by trapping during a considerable period.

A new preventive against the cabbage maggot.—About the year 1887 W. W. Tracy of Detroit, Michigan, undertook to prevent the entrance of the newly hatched larvæ of the cabbage root maggot (*Anthomyia brassicæ*) into the roots of the young cabbage plant by placing a piece of heavy manilla paper in a horizontal position closely about the stem at the surface of the ground. For various reasons this method did not prove satisfactory.

In the spring of 1889 it occurred to the writer to substitute tarred paper for the manilla paper previously used, with the additional protection of adding a bit of grafting wax to secure a union between the paper and the stem. This proved entirely successful. * * *

The next season (1890) preparations were made for a more extensive trial of the tarred paper cards, and a tool was devised for cutting out at one operation a hexagonal card, with a slit reaching to the center and a star-shaped cut at the center,

so that the same card may accommodate itself to any size of stem and still make a tight joint.

Cards were sent to a number of persons, but the season was not favorable for the development of the maggot, and reports were received from only two parties who had been troubled with these insects. In 1891 another trial with the same device was made by one of these parties on a more extended scale. In both years the results were satisfactory. The paper cards and the tool devised by the author for cutting them are illustrated.

The cards are cut in an hexagonal form in order to better economize the material, and a thinner grade of tarred paper than the ordinary roofing felt is used as it is not only cheaper, but being more flexible the cards made from it are more readily placed about the plant without being torn.

The cards should be placed about the plants at the time of transplanting. By bending the card slightly, the slit will open sufficiently to admit the stem of the plant to the center, after which the card should be spread out and the points formed by the star-shaped cut should be pressed snugly about the stem.

Experiments in spraying for the aphis.—Experiments with kerosene emulsion on apple trees and snowball bushes in the spring of 1891, before the buds opened, gave negative results, but "spraying with kerosene emulsion containing 13 per cent of kerosene April 24, just as the buds of the apple were beginning to burst, was almost entirely successful in destroying the Aphidæ. Spraying with the same strength on a viburnum bush two days after the buds had commenced opening appeared to do very little good."

Insecticides, F. J. NISWANDER (*Wyoming Sta. Bul. No. 7, July, 1892, pp. 8*).—Descriptive notes on the preparation and use of the arsenites, kerosene emulsion, pyrethrum, tobacco decoction, and bisulphide of carbon.

Entomological notes, H. OSBORN (*Iowa Sta. Bul. No. 17, May, 1892, pp. 144–152*).—This includes a summary of Farmers' Bulletin No. 7 of this Department, regarding the safety of eating sprayed fruit, and notes on observations by A. M. Sharp of Gladbrook, Iowa, on a number of insects attacking useful plants in 1891, and on a kind of bot on the necks of kittens, which caused their death.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor*.

Analysis of feeding stuffs, F. W. WOLL (*Wisconsin Sta. Report for 1891, pp. 203–219*).—The materials of which analyses are reported include refuse feeds from buckwheat mills, oatmeal factories, breweries, and starch and glucose factories, together with rye shorts, corn bran, corn meal, cotton-seed meal, and ship stuff. The analyses of some of these are given below.

Analyses of refuse materials for feeding stuffs.

	Water.	Composition of water free substance.						
		Ash.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.	Total nitrogen.	Albuminoid nitrogen.
Refuse from buckwheat mills:	*Per ct*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Buckwheat hulls	8.84	2.10	4.52	0.76	49.16	43.46	0.72	0.72
Buckwheat bran	8.74	2.62	8.05	2.27	42.05	45.01	3.16	2.98
Buckwheat bran	12.28	4.18	19.94	5.23	20.07	41.58	1.29	1.29
Buckwheat shorts	12.28	6.05	29 54	8.85	13.45	42.11	4.73	4.38
Buckwheat shorts	9.97	5.50	31.31	8.29	5.30	49.60	4.96	4.83
Buckwheat middlings	12.45	7.12	35.18	10.12	4.48	43.09	5.63	5.46
Buckwheat middlings	9.45	6.18	32.47	8.84	4.36	48.15	5.19	4.96
Refuse from oatmeal factories:								
Oat shorts	5.52	4.15	19.12	6.59	9.44	60.70	3.06	2.78
Ground feed	8.51	3.28	12.60	4.71	8.11	71.30	2.02	1.80
Oat dust	5.04	6.46	15.34	5.63	16.78	55.79	2.45	2.39
Refuse from starch and glucose factories:								
Glucose feed	71.66	5.58	17.60	9.01	12.14	55 67	2.82	2 53
Gluten meal	6.93	1 54	16.75	7.54	4.95	69.20	2.71	2 71
Starch refuse	7.55	1 68	14.72	9.29	8.80	65.51	2.36	2.28
Germ meal	6.80	1.25	11.69	4.63	10 57	71 86	1.87	......
Germ meal	9.87	1 01	11.19	6.17	12.54	69.09	1.79	......
Miscellaneous feeds:								
Corn bran	14.06	2 36	13.72	9.15	4.98	69 79	2.20	2.06
Barley feed	6.31	5.92	20.57	1.77	13.75	57.99	3.29	3.07
Locust bean meal	9.99	2.72	5.84	0.47	7 01	83.96	0.93	0.71

The various operations in the milling processes and the structure of the buckwheat grain are indicated by the composition of the different products, as given above. In the milling process the hulls are first separated from the inner portions of the grain; the first analysis given shows the composition of the pure hulls. * * * The shorts and middlings are composed of the seed coats of the grain with the layers lying close to them, with a greater or smaller admixture of the hulls. They are valuable as cattle foods in an inverse proportion to the quantity of hulls they contain. * * * The oat dust is obtained in the first hulling operation of the kiln-dried oat grains, from the end "fuzz," with a small portion of the starchy part of the grain. The "ground feed" is a mixture of oat shorts and corn. * * *

The glucose feed or "sugar feed" as it is sometimes called, is a wet feed that must be fed at once to prevent its fermenting. The starch refuse constitutes the coarse portion of the corn from which most of the starch has been removed, and it is made up of the germ, gluten, and hulls of the corn. It is dried by pressure and subsequently by steam drying. The gluten meal is prepared from this feed by separating the coarse hulls and germs from the finer portion, either before pressing and drying or after the process of drying. The germ meal is a refuse feed from starch factories. It has come into some prominence of late as a cattle food; the corn is heated for eight hours at 140° F., and after a certain per cent of starch has been taken out it is kiln-dried and ground. * * * The corn bran is a cheap refuse feed, with a fair proportion of protein and rich in ether extract and starchy matter, and it would seem that it is well worthy of a trial; it may be had usually at $5 per ton, but has been sold for $10 per ton during the past season of high prices for cattle foods. * * *

The barley feed consists of cleanings and scourings of malt sprouts, and no great claims are made for it by the manufacturers, it being sold at a nominal price. * * *

The locust bean meal is said to be used extensively in this country and in Europe as an ingredient of calf meal. It is the locust bean (from honey locust) ground together with the sweet pod.

A discussion is given on the commercial valuation of feeding stuffs, and a calculation is given of the valuation per ton of the feeding stuffs here reported on, the valuation being based on the author's figures,

protein 1.5 cents, fat 3.6 cents, and carbohydrates 0.47 cents per pound. These are said to be the prices ordinarily paid for these food ingredients in concentrated cattle foods in Wisconsin.

Ccmposition of some feeding stuffs, G. H. FAILYER and J. T. WILLARD (*Kansas Sta. Bul. No. 32, Dec., 1891, pp. 225–228*).—Analyses with reference to food ingredients are given of stock melons, sugar beets, sugar beet tops, 2 varieties of sweet potatoes, artichokes, prairie hay and millet hay raised upon the station farm, and of linseed meal, wheat bran, shorts, middlings, and sorghum seed. The composition of part of these is as follows:

Composition of feeding stuffs grown in Kansas.

	Water.	Composition of dry matter.				
		Ash.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Stock melons	95.22	7.40	9.38	0.81	21.15	61.26
Sugar beets (roots)	84.04	4.84	11.03	0.19	5.93	78.01
Leaves of sugar beets	87.89	16.23	19.52	2.01	8.83	53.41
Sweet potatoes						
Southern Queen	69.77	3.60	5.88	0.93	2.86	86.73
Red Bermuda	71.32	3.87	6.58	0.68	2.57	86.30
Artichokes (fresh)	81.50	5.33	12.08	0.60	3.43	78.56
Millet hay	7.96	8.91	9.27	1.60	32.73	47.49
Prairie hay (upland)	8.60	8.93	5.24	2.71	30.69	52.43

Composition of Kaffir corn, oats, and wheat at different stages of growth, G. H. FAILYER and J. T. WILLARD (*Kansas Sta. Bul. No. 32, Dec., 1891, pp. 229–232, plate 1*).—Analyses of the kernels and fodder of Kaffir corn, white variety, and of the grain of oats and wheat cut at different stages of growth are given as follows:

Composition of Kaffir corn, oats, and wheat at different stages.

Kind and condition of plant.	Date of collecting samples.	Water.	In dry matter.						
			Crude ash.	Crude protein.	True albuminoids.	Non-albuminoid nitrogen.	Crude fat.	Crude fiber.	Nitrogen-free extract.
Kaffir corn, fodder:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct*	*Per ct.*	*Per ct.*	*Per ct.*
Seed in soft milk	Aug. 27	7.37	9.80	8.63	6.44	0.35	2.36	33.91	45.30
Seed in soft dough	Sept. 4	6.08	8.95	7.28	5.57	0.28	1.72	34.80	47.16
Seed in hard dough	...do	9.75	10.12	7.56	5.89	0.27	2.30	33.43	46.59
Seed hard, easily split	Sept. 17	7.13	9.61	6.55	5.71	0.14	1.88	33.97	47.99
Seed hard, nearly ripe	Oct. 3	8.67	8.56	5.86	4.82	0.17	1.84	33.59	50.15
Kaffir corn, grain:									
Seed in soft milk	Aug. 27	10.02	2.29	15.24	14.93	0.05	2.87	3.02	76.58
Seed in soft dough	Sept. 4	9.37	1.95	12.38	12.48	......	3.32	2.21	80.14
Seed in hard dough	...do	9.89	1.91	12.42	12.23	0.03	2.89	1.83	80.95
Seed hard, easily split	Sept. 17	9.70	1.77	11.94	11.74	0.03	3.60	1.71	80.98
Seed hard, nearly ripe	Oct. 3	9.31	1.86	12.06	11.92	0.02	3.61	1.64	80.83
Oats, grain:									
Seed in milk	June 27	10.51	4.91	14.45	12.06	0.38	5.09	18.45	57.10
Seed in dough	July 6	10.56	4.39	12.17	11.02	0.19	6.46	10.38	66.60
Seed ripe	July 12	9.70	4.45	12.46	11.59	0.14	6.20	9.61	67.28
Wheat, grain:									
Seed in soft dough	June 11	12.48	1.03	16.98	13.60	0.54	1.84	2.75	76.40
Seed ripe	June 18	11.82	1.80	15.94	12.19	0.60	1.69	2.54	78.03

The table shows that both the fodder and the grain of the Kaffir corn rapidly decreased in albuminoids between the first and second stages, and slowly thereafter. In the fodder the fiber was nearly constant, but it decreased in the grain. The nitrogen-free extract, sometimes called carbohydrates, increased in both parts of the plant. The non-albuminoid nitrogen is more abundant in the growing plant than in the mature one. All of these changes are percentage changes. They are in the main the result of greater increase of some constituents than of others. Thus, although there is a percentage decrease in the albuminoids, there is a greater total weight in the grain when ripe than at any previous time, being more than twice as much at the last cutting as at the first. In the fodder there was a slight decrease in the whole amount of protein.

The conclusion must be, that it is more profitable to harvest the crop when ripe or nearly so than at any earlier time. This is true when fodder is an important consideration as well as when the grain is most important.

What has been said upon the variations of the composition of Kaffir corn grain applies with little modification to the oats and the wheat. The first cuttings of Kaffir corn were made at an earlier stage of development. This may account for the greater variations of Kaffir corn than is observed in the other grains.

Analyses of fodder articles (*Massachusetts State Sta. Bul. No. 42, June, 1892, pp. 13–16*).—Analyses of gluten meal, corn-germ feed, maize feed, corn meal, ground barley, cotton-seed meal, and chicken feed (ground meat scraps). Some of these are given below:

	Gluten feed.		Corn-germ feed.	Maize feed.	Ground barley.	Ground meat scraps.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*
Moisture	6.81	8.97	7.55	8.60	10.91	3.71
Composition of dry matter:						
Crude ash	1.81	0.77	0.87	0.92	3.19	35.61
Crude cellulose	6.39	5.09	14.05	7.93	4.10	....
Crude fat	11.73	13.46	12.17	7.90	2.13	20.31
Crude protein	28.43	26.16	10.81	29.40	13.33	40.08
Nitrogen-free extract	51.64	54.52	62.10	53.85	77.25	....
	100.00	100.00	100.00	100.00	100.00	....

Composition of feeding stuffs, F. W. WOLL (*Wisconsin Sta. Report for 1891, pp. 193–202*).—A popular explanation of the terms used in the analysis of feeding stuffs; the composition and the per cent of digestible materials in various feeding stuffs; Wolff's feeding standards, with explanations of their use; and directions for compounding rations.

Feeding experiments with milch cows, C. A. GOESSMANN (*Massachusetts State Sta. Bul. No. 42, June, 1892, pp. 13*).

Synopsis.—A comparison on four cows of silage from dent and sweet corn with corn stover from the same varieties, the grain ration remaining constant. The stover rations proved cheaper than those containing silage.

The experiments described were with four cows from 5 to 8 years old, mostly well advanced in milk. The trial extended from November 8 to March 22, including five feeding periods of from two to five weeks each. During four periods, feeding a constant grain ration of 3 pounds each of wheat bran, maize feed, and cotton-seed meal per cow, a comparison was made between corn stover from Stowell Evergreen sweet corn

and Pride of the North dent corn and the silage made from these 2 varieties. The stover and silage were both fed *ad libitum*. Hay (5 pounds per head) was fed in each silage period. In a fifth period the cotton-seed meal was replaced by 3 pounds of corn meal, and the coarse fodder consisted of hay and sugar beets. The corn for the silage was cut when the kernels were beginning to glaze. The stover was from the matured crop and was field-cured. It was cut for feeding. The maize feed is described as "one of the waste products of corn obtained in connection with the manufacture of glucose sugar. * * * It represents the dried grain residue of the maize kernels after the principal part of its starchy material has been removed, and contains more or less of the broken up skins of the kernels." The analyses of the feeding stuffs used, with reference to both food and fertilizing ingredients, are tabulated, together with the average milk yield in each period, weekly analyses of the milk, live weight of the animals, and total and net cost of the rations. There was a gradual decline in the average milk yield, as was to be expected, but this is believed to be normal. There is no indication from the data given that it was affected by the changes of coarse food; neither were there any uniform changes in the composition of the milk which could be attributed to change of food. The following are the market prices of the feeding stuffs used and the percentage and valuation of the fertilizing ingredients in the same. Nitrogen is valued at 15 cents, phosphoric acid at 5½ cents, and potash at 4½ cents per pound.

Cost of foods and percentage of fertilizing ingredients in the same.

	Corn meal.	Wheat bran.	Maize feed.	Cotton seed meal.	Hay.	Sweet corn stover.	Dent corn stover.	Sweet corn silage.	Dent corn silage.	Sugar beets.
Moisture..........per cent..	13.26	10.01	8.70	7.05	9.72	41.62	20.10	84.30	79.92	85.27
Nitrogen..............do....	1.79	2.60	4.03	5.77	1.38	0.57	0.99	0.20	0.27	0.26
Phosphoric acid.....do....	0.71	2.85	0.70	2.33	0.36	0.20	0.29	0.09	0.14	0.10
Potassium oxide......do....	0.44	1.63	0.43	1.72	1.57	1.00	1.40	0.41	0.33	0.48
Valuation per 2,000 pounds..	$6.55	$12.40	$13.25	$21.42	$5.95	$2.83	$4.55	$1.06	$1.26	$1.32
Market price................	31.00	22.00	25.00	29.00	15.00	5.00	5.00	2.50	2.50	5.00

The gross cost of the daily ration was greater with the silage (19.15 and 20.32 cents) than with the stover (14.42 and 15.04 cents), the higher price in each case representing the sweet corn. The hay fed with the silage probably increased the cost of those rations. Assuming 80 per cent of the fertilizing ingredients to be recoverable and valuing these on the basis given above, the net cost of the fodder rations was 6.58 and 7.75 cents per day, respectively, and of the silage rations 10.69 and 11.72 cents. In the period in which corn meal was substituted for cotton-seed meal and sugar beets and hay for corn stover, the net cost of the ration was 16.7 cents per day. The stover rations therefore proved the cheapest rations in every respect, and the dent stover ration cheaper than the sweet corn stover, presumably because less dent stover was eaten.

The relative value of corn silage and field-cured fodder corn for milk and butter production, F. W. WOLL (*Wisconsin Sta. Report for 1891, pp. 19-60*).

Synopsis.—A comparison on twenty cows of corn fodder and silage from the same. One lot was fed the corn fodder ration and the other the silage ration the first period, and in the second period the lots were reversed, the same amounts of grain and hay being fed at all times. Pound for pound of dry matter the corn fodder was slightly more effective. The calculated yield of milk and butter per acre of land was in favor of the silage.

This experiment is in continuation of others on the same subject made in previous years and published in the annual reports of the station. Abstracts of the more recent of these are given in E. S. Bul. No. 2, part I, p. 192, and E. S. R., vol. II, pp. 430 and 440.

In the experiment here described, twenty cows, all new in milk, were used. These were divided into two lots, which were alternated on the silage and fodder rations. The rations consisted of 4 pounds of hay, 5 pounds of wheat bran, and 2 pounds of wheat shorts, with either silage or dry fodder corn *ad libitum*.

The experiment proper began December 15, 1890, after a week of preliminary feeding. The first period lasted until February 9, when the feeds were reversed, and the ten cows having received silage during the first period were fed dry fodder corn during the second period, and *vice versa*. The week following the first period was not considered as belonging to the experiment proper. The second period lasted from February 16 to April 13, making the number of days in which the experiment was conducted one hundred and twelve in all.

Both the silage and the fodder corn were from Burrill and Whitman Ensilage and Pride of the North yellow dent corn. Samples of the feeding stuffs were taken weekly at the time of weighing out. The cows were milked at 5 a. m. and 4:30 p. m., the weight of milk at each milking being recorded. Every third or fourth week the morning's and night's milk of each cow was sampled and tested by the Babcock method for a period of seven days. In all six such tests were made. During the weeks when the milk was analyzed the cows were weighed daily in the forenoon, and the water drank by each animal was also weighed. The total food eaten at each feeding was recorded and also any small residue that was left. "The silage was eaten up clean throughout the experiment and the cows seemed to take it in preference to hay." The data given as a rule include only average figures.

The animals kept up very well in live weight during the whole experiment, so that at the close they weighed on an average more than at the beginning four months earlier. The average weight of the cows while on silage was 28.9 pounds greater than while on fodder corn, the increase in live weight ranging from 62.5 to 5.6 pounds. All the cows but one weighed more when on the succulent ration. * * * The cows drank on an average 23.7 pounds more water while on fodder corn than when they were on silage. * * * Besides 4 pounds of hay and 7 pounds of grain feed per head the cows ate daily on an average 59.3 pounds of silage, containing 16.29 pounds of dry matter, and during the dry fodder periods 18.71 pounds of fodder corn,

containing 13.51 pounds of dry matter. This shows, as has been found in previous work in this line, that cows will eat more when fed silage than when fed fodder corn, when they get all they want in both cases.

In all 64,643 pounds of silage were fed out to the twenty cows during the experiment and 20,394 pounds of fodder corn, equal to 17,743 pounds and 14,726 pounds of dry matter in silage and fodder corn respectively.

The total milk yield of the cows during the whole experiment [was 19,813.4 pounds on the silage ration and 19,801.2 pounds on the fodder corn ration]. This difference of 12.2 pounds of milk in favor of the silage feed is of course too minute to have any significance whatever. * *

As regards the production of milk fat, we have data for six weeks for each feed. The total quantity of milk and milk fat produced during this time are given in the following table:

Table showing yield of milk and milk fat.

	On silage.	On fodder corn.	Difference in favor of silage.
	Pounds.	*Pounds.*	*Pounds.*
Total milk yield for six weeks	7,440.30	7,255.10	185.20
Total fat in milk during six weeks	337.70	324.14	13.56
Average per cent of fat in milk	4.54	4.47	....

Calculating the quantities of milk and milk fat produced by the same quantity of dry matter, we notice that during the six weeks when milk analyses were made the fodder corn ration was somewhat more productive. While, as we learned, the cows ate more dry matter on silage than on fodder corn in these weeks and produced more milk and milk fat, the increase in yield did not come up to increase in fat content, and consequently 100 pounds of dry matter in the fodder corn ration produced somewhat more than the same quantity in the silage ration. * * *

When we consider the total quantity of the same food consumed by the 20 cows during the whole experiment, and also the milk produced, we notice that 28,160.9 pounds of dry matter during the silage period produced practically the same quantity of milk as did the 25,143.9 pounds of dry matter during the fodder corn periods. Putting it in a different form, we find that 100 pounds of dry matter in the fodder corn ration produced 78.7 pounds of milk, and in the silage ration 70.4 pounds of milk, a difference in favor of the fodder corn ration of 8.6 pounds, or 12 per cent.

This is exactly the same result as obtained in last year's experiment, the dry matter in the fodder corn giving a 12 per cent better result in the milk yield, or 1 pound of dry matter in the fodder corn ration produced the same results as 1.12 pounds of dry matter in the silage ration.

Considering the relation between the milk produced by the cows and the area of land from which the fodder fed in both cases was obtained, it is found by calculation that with the silage from 1 acre 377 pounds more milk was produced than with the dry fodder from the same area. But to accomplish this 81 pounds more hay and 141 pounds more grain were fed with the silage than with the fodder corn from an acre. Allowing $7 per ton for the hay, $15 per ton for the grain, and $1 per 100 pounds for the milk, the net profit of the silage over the fodder corn from 1 acre is shown to be $2.43. This takes account only of the first cost of the feed, without reference to the question of labor.

This $2.43 would represent 243 pounds of milk at $1 per 100 pounds, which would correspond to about 12 pounds of butter.

It will be remembered that this result is obtained on an experiment with twenty cows that were fed the product of nearly two thirds of an 8¾-acre field. Considerable confidence is therefore placed in the correctness of the results and the general applicability of the conclusions drawn to the conditions of our general Wisconsin farmers. Summarizing our work in this line, we have the following conclusions:

(1) A daily ration of 4 pounds of hay and 7 pounds of grain feed, with corn silage or field-cured fodder corn *ad libitum*, fed to twenty cows during sixteen weeks, produced a total quantity of 19,813.4 pounds of milk during the silage periods and 19,801.2 pounds of milk during the fodder corn periods.

(2) When we consider the areas of land from which the silage and fodder corn fed were obtained, we find that the silage would have produced 243 pounds more milk per acre than the dry fodder, or the equivalent of 12 pounds of butter. This is a gain of a little more than 3 per cent in favor of the silage.

A preliminary experiment on the influence of imperfect ventilation upon milch cows, F. H. KING (*Wisconsin Sta. Report for 1891, pp. 61-68*).

Synopsis.—In two experiments with twenty and twenty-five cows, respectively, made to observe the effects of good and poor ventilation, the yield of milk was larger in the periods of good ventilation than in those of poor ventilation.

To study the relative effects of good and poor ventilation upon milch cows, an experiment was commenced April 8 with twenty animals. After a preliminary period extending to April 19 the experiment proper began and continued for fourteen days, which were divided into six periods, four of two days and two of three days each.

In the first, third, and fifth periods the animals were under the influence of poor ventilation, and in the second, fourth, and sixth periods under good ventilation. A record was kept of the yield of milk, water drank, temperature of the stable, and the weights of the animals, and the results of these observations are tabulated. These show that slightly more milk was produced during the periods of good ventilation, that the cows drank on an average 11.4 pounds more water per day under the conditions of poor ventilation, and that "in all cases the the mean weight of the herd increased under the conditions of good ventilation, while under the reverse conditions there was a loss, the average amount per cow being 10.75 pounds for each change."

There was a difference of 6.3° F. in the mean temperature of the stable during the well and poorly ventilated periods, and this difference probably explains, in part at least, the greater amount of water drank during the periods of poor ventilation. * * *

The differences in ventilation do not appear to have had an appreciable influence upon the quantity of food eaten, for the amounts consumed under both conditions were practically the same.

In another experiment with twenty-five cows, lasting one hundred and twenty-two days, an attempt was made to observe the effects of small difference in ventilation by closing the two large ventilators in the stable on alternate nights. In this, as in the preceding experiment, there was a slight balance in milk yield in favor of the more perfect ventilation.

Feeding milk to cows, J. WILSON and G. E. PATRICK (*Iowa Sta. Bul. No. 17, May, 1892, pp. 389–392*).

Synopsis.—Whole milk and skim milk fed to two Holstein cows at pasture seemed to keep up the yield and quality of milk at a time when pastures were drying up and when shrinkage was general with all cows on pasturage alone.

Two Holstein cows, nearly new in milk, were fed from June 21 to August 29, in four periods, as follows: Period 1, pasturage and 40 pounds of whole milk per head daily for twenty-six days; period 2, pasturage alone for nine days; period 3, pasturage and 40 pounds of skim milk per day for fourteen days; and period 4, pasturage alone. The pasturage was on a good blue grass pasture. No grain of any kind was given. The milk produced in each period was tested by means of composite samples analyzed every four or five days. The milk of each cow was weighed at each milking. These results and the calculated amounts of total solids and of fat are tabulated. The average composition of the milk in each period and the average yield per day of milk, solids, and fat are here given.

Daily averages by periods.

	Cow No. 155.					Cow No. 151.				
	Yield of milk.	Total solids in milk.		Fat in milk.		Yield of milk.	Total solids in milk.		Fat in milk.	
	Lbs.	*Per ct.*	*Lbs.*	*Per ct.*	*Lbs.*	*Lbs.*	*Per ct.*	*Lbs.*	*Per ct.*	*Lbs.*
Pasturage and whole milk, June 21–July 16	39.7	12.06	4.788	2.98	1.183	32.8	11.71	4.612	3.14	1.032
Pasturage alone, July 17–25	34.7	11.86	4.117	2.75	0.959	27.9	11.37	3.170	2.95	0.823
Pasturage and skim milk, July 26–Aug. 8	32.4	11.78	3.855	2.77	0.925	27.6	11.21	3.089	2.88	0.701
Pasturage alone, Aug. 9–29	27.6	11.23	3.295	2.72	0.747	23.6	11.38	2.731	2.91	0.686

In both cases feeding milk had the effect of keeping up the flow of milk and its quality as well. The pastures dried up during the summer and "shrinkage was general with all cows that had nothing but pasturage." As soon as the milk or skim milk was discontinued the milk shrunk in quantity and in solids and fat.

Feeding beets and potatoes for butter, J. WILSON, D. B. BISBEE, and F. A. LEIGHTON (*Iowa Sta. Bul. No. 17, May, 1892, pp. 371–377*).—With a view to testing the value of sugar beets and potatoes for butter production, two lots of two cows each were fed from December 1 to July 29, lot 1 receiving sugar beets and lot 2 potatoes. Lot 1 consisted of a Shorthorn cow and a Holstein heifer, and lot 2 of a Shorthorn cow and a high-grade Jersey heifer. From 20 to 50 pounds of beets per head were fed daily and from 10 to 50 pounds of potatoes. With these corn fodder and a varying grain ration were fed. Butter was made from the milk of each lot on three dates, January 19, January 25, and February 22. The data obtained on these occasions are given. It is stated that the butter from the lot receiving sugar beets was of better flavor and color and kept better than that made from the lot receiving pota-

toes, but that "the higher grades of butter can not be made from heavy feeding of either raw sugar beets or raw potatoes."

Winter rations for breeding ewes, J. A. CRAIG (*Wisconsin Sta. Report for 1891, pp. 5–14*).

Synopsis.—A comparison was made of rations containing either dry corn fodder, oat straw, or hay, and those containing corn silage, clover silage, or sugar beets, for wintering breeding ewes. Mixed grain rations were fed in each comparison. Of the dry fodders the cut corn fodder on the whole gave the best results, although the oat straw ration gave good results and was the cheapest ration. Corn silage led the succulent fodders and was more satisfactory than sugar beets.

Two experiments are reported, each with 12 high-grade Shopshire ewes, lasting eight weeks, from January 21 to March 18. Both were made to compare different coarse fodders when a constant grain ration was fed. The current market prices of the food used were, corn fodder $4, corn silage $2, clover silage $2, oat straw $3, hay $8, sugar beets $2, and bran $12 per ton, and oats 30 cents per bushel.

Comparison of dry fodders.—The ewes were divided into three lots of four each, all receiving like amounts of oats, bran, and sugar beets. In addition lot 1 received cut corn fodder, lot 2 oat straw, and lot 3 blue grass hay, each fed *ad libitum*. The object was not to fatten the animals, but to keep them in good condition for breeding. There was a small average gain for each lot. Slightly more corn fodder was consumed than hay or oat straw, but the amount refused was also larger with corn fodder.

Following is the cost of the rations of the different lots:

	Lot 1 (corn fodder).	Lot 2 (oat straw).	Lot 3 (hay).
Cost of food for four ewes for eight weeks	$2.30	$1.910	$2.890
Cost of food for one ewe for one day	0.01	0.008	0.012

(1) Cut corn fodder gave the best results, as the ewes so fed were maintained cheaply, they kept in the best health, their fleeces were in the best condition, and after lambing they gave the most abundant supply of milk.

(2) Oat straw as a fodder for sheep is shown by this experiment to have a higher feeding value than is commonly credited to it. Combined with a small quantity of grain and succulent food it offers the best ration for carrying breeding ewes over winter at the least expense. Ewes were kept in good condition on a ration consisting largely of oat straw at a cost of less than a cent a day. * * * While it would not be proper to recommend an exclusive straw and grain ration on this trial alone, yet it is evident that oat straw may be with profit more largely used with other fodders.

(3) While hay is a good dry fodder for sheep, yet looking for the best results and closest economy it would be better to give the preference to oat straw and corn fodder, where these fodders are available at the valuation given in our scale of prices.

Comparison of succulent fodders.—As in the preceding experiment, the ewes were divided into three lots of four each and all received the same ration of oats, bran, and hay. In addition to these, lot 1 received corn silage, lot 2 clover silage, and lot 3 sugar beets. Of these,

the ewes were fed only enough to keep them in good breeding condition, the amounts given being practically the same for all three lots. Each lot made a slight gain in weight. The cost of the several rations was as follows:

	Lot 1 (corn silage).	Lot 2 (clover silage).	Lot 3 (sugar beets).
Cost of food for four ewes for eight weeks	$2.67	$2.91	$2.76
Cost of food for one ewe for one day	0.011	0.013	0.012

(1) Corn silage is a valuable fodder for breeding ewes, surpassing the other succulent fodders used in this experiment in its cheapness, by keeping the sheep in good, thriving condition, and leading to a good flow of milk.

(2) Clover silage if properly preserved is a good sheep food. The sheep after getting used to it eat it with avidity and do well on it. Against it is the cost of making and the difficulty in preserving it.

(3) Sugar beets are liked by sheep, but they can not be said to equal either of the other succulent fodders experimented with. They are apt to induce scouring if fed in quantities of over 4 pounds daily to each ewe.

Influence of different rations on the growth of wool and increase in live weight of fattening sheep, J. A. Craig (*Wisconsin Sta. Report for 1891, pp. 11–23*).

Synopsis.—A comparison of a carbonaceous with a nitrogenous diet for wethers. Two lots of 6 animals each were fed the respective rations for twelve weeks. The cheapest gain in live weight was made on the carbonaceous ration, although a larger gain in weight and slightly more wool were produced on the nitrogenous ration.

In the study of this question twelve grade Shropshire wethers were used, averaging about 9 months old at the commencement of the trial. They were shorn and then divided into two lots. After an introductory period of two weeks they were fed for twelve weeks (January 19 to April 13) as follows: Lot 1, a carbonaceous ration consisting of shelled corn, cut corn fodder, and corn silage, having a nutritive ratio of 1:10; and lot 2, a nitrogenous ration composed of equal parts of oats and oil meal, and clover hay and clover silage, having a nutritive ratio of 1:3.6. Both lots were given all they would eat of the respective rations. The current prices of the materials composing the rations were, corn fodder $4, clover hay $8, corn and clover silage $2 each, and oil meal $20 per ton, and oats 30 cents and corn 40 cents per bushel. The table of weekly gains in live weight shows that lot 1 gained 181 pounds on the carbonaceous ration and lot 2 gained 214 pounds on the nitrogenous ration.

In lot 1 there were two wethers that did not develop as they should have done had they been thrifty. They were never unwell, yet they were always poor feeders. During the period they gained only 24 pounds and 25 pounds, respectively. In lot 2 there was one wether that was also unthrifty, as it only gained 26 pounds during the experiment. Had these wethers been of average vigor the cost of gain would have been materially reduced and the difference between the lots in the total gain might have been much less.

The financial results for each lot were as follows:

	Lot 1 (carbonaceous).	Lot 2 (nitrogenous).
Cost of food consumed	$6.70	$11.85
Cost of food per pound of gain in live weight, including wool	0.037	0.0553

"Considering the cost of gain made by the two lots, we find that lot 1 increased in live weight at a rate of $1.80 cheaper per 100 pounds gain than lot 2. In the experiment of a similar nature conducted last year [Annual Report of the Station for 1890, p. 16; E. S. R., vol. II, p. 437] the lot fed a carbonaceous ration made not only the cheaper gain, but also slightly the greater."

The length of the wool was measured half way between the shoulder and the elbow, the loss by washing determined, and the parts of the body weighed at the time of slaughtering. These data are tabulated.

Slightly better results in wool growth were obtained from the wethers that were fed the nitrogenous ration, as they clipped a total of 2.6 pounds unwashed and 0.8 pound washed wool more than those fed the carbonaceous ration. The difference in the weight was due almost altogether to the greater amount of yolk in the fleeces in the wethers that received the nitrogenous ration. The fleeces of lot 1 lost 29 per cent of their weight in the tub-washing and those of lot 2, 31 per cent.

There was no uniformity in the differences of the lots in regard to the mixture of fat and lean in the carcasses.

[The results of this trial are compared with those of a previous trial referred to above.] The figures will show that not only does the fattening of sheep supply the farmer with a steady and easily accessible market on his farm for some of his farm produce, but also yields him a good margin of profit.

Shearing wethers in winter before fattening them, J. A. CRAIG (*Wisconsin Sta. Report for 1891, pp. 23–27*).

Synopsis.—A trial was made with two lots of three wethers each, one of which was shorn at the beginning of the trial and the other left unshorn. Both lots received the same food *ad libitum*. The unshorn lot produced the larger gain of live weight and of wool and at the least cost. The trial was unfavorable to shearing.

December 12 six wethers, "of similar breeding and much alike in fleece and type," were selected and divided into two lots weighing 291 and 282 pounds respectively. One lot was shorn at once and the other left unshorn. After a preliminary period of two weeks the experiment proper began February 2 and continued until April 20. At the beginning of the experiment the unshorn lot weighed 302 pounds and the shorn lot 296 pounds. Both lots were given all they would eat of meadow hay, sugar beets, and a grain mixture consisting of one part of oil meal, one part of oats, and four parts of whole corn by weight. The tabulated results of food eaten and weekly gains in live weight show that in eleven weeks the shorn lot gained 120 pounds in live weight at a cost of $5.64, or 4.7 cents per pound, and the unshorn lot gained 127 pounds live weight at a cost of $5.55, or 4.4 cents per pound.

The cost of the rations is calculated on the market prices given in the above experiment with breeding ewes.

It will be seen that lot 2, left unshorn, not only made a greater total gain than the shorn wethers of lot 1, but also made a cheaper gain. It remains to be said that the temperature of the sheep shed in which these wethers were fed had no doubt some influence on the results of the experiment. * * * The average temperature of the shed during the period of experiment was about 35° F.

The production of wool was as follows: At the first shearing, December 12, lot 1 (shorn) yielded a total of 16.4 pounds, and at the second shearing, April 24, 12.1 pounds, making a total of 28.5 pounds. The unshorn lot when shorn April 24 gave a total of 32.7 pounds of unwashed wool, or 4.2 pounds more than lot 1. On the basis of that assumption, the unshorn lot would have yielded 16.4 pounds of wool, the same as the shorn lot, if they had been shorn December 12. It is seen that during the experiment the unshorn lot produced 16.3 pounds of unwashed wool as compared with 12.1 pounds produced by the shorn lot in the same time. In tub-washing the fleeces of the shorn lot lost 36 per cent and those of the unshorn lot 44 per cent, showing that the latter contained 8 per cent more yolk than the former. The wool from the shorn lot was naturally much shorter in staple. Subtracting the weight of the wool produced from the total gain in live weight, the actual gain in flesh was found to be 107.9 pounds for the shorn lot and 110.7 pounds for the unshorn lot, a difference of only 2.7 pounds.

Both lots were slaughtered and the data secured are tabulated. These show material difference between the two lots.

As the results of this single trial it appears that—

(1) When fed in common sheep sheds of an average temperature of 35° F. it is not advisable to shear fattening wethers in December.

(2) The wethers left unshorn gave in this trial the greater gain in wool and mutton combined at the least cost.

(3) The unshorn wethers yielded the greater weight of wool, and that also of a more marketable length of staple, though it contained slightly more yolk.

(4) The unshorn wethers made the greater gain in flesh, and in addition the mutton did not differ in its proportions of fat and lean from that of the shorn lot.

Feeding grain to lambs before weaning them, J. A. CRAIG (*Wisconsin Sta. Report for 1891, pp. 27–33*).

Synopsis.—A comparison on three lots of three ewes and three rams each of feeding grain to the lambs or the same amount to the ewes and of feeding no grain, the animals in each case being on good pasturage. The best results were shown from feeding grain to the lambs. The result was better than when the grain was fed to the ewes instead of the lambs. The inference was that lambs should be taught to eat grain as early as possible.

To ascertain whether grain could be profitably fed to lambs running with their dams on good pasture, and if so whether it was better to feed it directly to the lambs or to the ewes, nine high-grade Shropshire ewes with nine lambs were selected. The ewes and lambs were uniform in type and quality, having been sired by the same ram. They were

divided into three even lots. In the case of lot 1 the lambs received all they would eat of a mixture of one part corn meal, one part bran, and one fourth part oil meal by weight, the ewes receiving only pasturage. The lambs of lot 2 received no grain, but the same amount of grain was fed to the ewes as was consumed by the lambs in lot 1. Neither the ewes nor lambs in lot 3 received any grain. All the lots were kept on pasturage of a similar character. During rainy weather the lots were kept in sheds, receiving roots, corn fodder, and hay, the amounts of which were noted and charged to each lot. The feeding lasted from April 30 to July 9—ten weeks. The data as to the food consumed, gain in live weight, and cost of the food are tabulated. The author draws the following conclusions:

(1) It is good management to feed the lambs before weaning them all they will eat of such grain mixtures as that used in this experiment. The lot of three lambs so fed made an excess gain over the lot receiving no grain of 25 pounds during ten weeks at a cost of 56 cents.

(2) To feed the ewes the grain mixture instead of the lambs is not likely to give as good results as feeding it to the lambs direct, though it does seem that a combination of both practices would be the best.

(3) To make the cheapest and the greatest gain for each pound of grain consumed the lambs should be taught to eat grain as early in life as possible.

Feeding lambs, C. F. CURTISS (*Iowa Sta. Bul. No. 17, May, 1892, pp. 378–384*).—The results are reported of feeding three lots of from two to three lambs each for a period of one hundred and twenty-one days—December 1 to April 1—as follows:

Lot 1, oats, oil meal, bran, and hay; nutritive ratio 1:6.5.
Lot 2, shelled corn, hay, and oat straw; nutritive ratio 1:11.9.
Lot 3, oats, shelled corn, bran, oil meal, and hay; nutritive ratio 1:7.2.

At the beginning of the experiment lot 1 (three lambs) weighed 211 pounds, lot 2 (three lambs) 207 pounds, and lot 3 (two lambs) 135 pounds. Each lot was kept by itself and given exercise in the open air daily. Salt was accessible to them at all times. The average gain in live weight per animal in lot 1 was 25 pounds; in lot 2, 13½ pounds; and in lot 3, 20 pounds. With oil meal at $25, bran at $16, hay at $5, and straw at $2 per ton, and oats at 25½ cents and corn at 30 cents per bushel, the gain in live weight of lot 1 cost 6.2 cents per pound; of lot 2, 5.7 cents per pound; and of lot 3, 5.65 cents per pound.

"The corn-fed lambs made no apparent growth. The gain in weight seemed to be the result of fattening instead of growing." The ration of lot 3 "gave the cheapest gain and on the whole the most satisfactory results, although the gain was less than that of the lambs on the narrow ration. The lambs in this lot made a satisfactory growth and improvement in flesh." A lamb from lot 1 sheared 3 pounds of wool and one from lot 2, 3 pounds. Both had been sheared the previous October. "There was no appreciable difference in the market value of the wool." On slaughtering these two lambs little difference was seen in

the quality of the mutton, though that from lot 1 was believed to be "rather more juicy and tender than that of the corn-fed lot."

Winter feeding of hogs (*Iowa Sta. Bul. No. 17, May, 1892, pp. 385–388*).—The indications from a trial of feeding three sows from one and a half to three years old and six shoats on corn-and-cob meal, ear corn, ground oats, buttermilk, and bran or oil meal, were "that when corn is 25 cents per bushel and hogs 4 cents a pound winter feeding will pay better than selling the corn, and that young hogs will yield a greater profit than old ones."

Feeding value of whey, W. A. HENRY (*Wisconsin Sta. Report for 1891, pp. 38–48*).—This account of experiments in feeding whey to pigs is reprinted from Bulletin No. 27 of the station (E. S. R., vol. III, p. 48).

The result of crossing the Shropshire with the American Merino, J. A. CRAIG (*Wisconsin Sta. Report for 1891, pp. 33–37*).—Bearing on the question of grading up a flock of ewes for breeding mutton sheep and of the effect of the change from the growing of fine wool to the breeding of mutton sheep, an account is given of work commenced in 1889 of crossing Merino ewes with pure-bred Shropshire rams:

While there has been a material gain in the form of these sheep over that of the Merino for mutton-breeding, there has been an additional gain in the wool clipped; for that from the first cross used brought us a higher price in the Chicago market than that of either our Merinos or Shropshires. * * * From the results obtained it seems reasonable to expect that with three, or at most four top crosses of such a breed as the Shropshire upon even such an extremely different type as the Merino, offspring would result that could not practically be distinguished from the pure-bred Shropshire. The time it will take to reach that degree of development will depend to a considerable extent on the impressive power of the rams that are used. By observing the results of using the rams employed in this work on the other ewes of our flock, we are satisfied that they did not possess more than common impressive powers. Yet we have lambs, with only two top crosses of the Shropshire or Merinos, that are not easily distinguished from others of pure Shropshire breeding. The importance of this to the farmer lies in the fact that by purchasing a pure-bred mutton ram of ordinary constitutional vigor he may hope to establish in four years a flock of high-graded mutton sheep that will approach near to the best type of any of the mutton breeds.

VETERINARY SCIENCE.

Chemical compounds for preventing the growth of horns on cattle, L. H. ADAMS (*Wisconsin Sta. Report for 1891, pp. 289–291, plates 2*).—The successful use is reported of two compounds, the names of which are not mentioned.

It was found in a majority of instances that the best results were reached when the compound was applied as soon as it was possible to locate the little horn button on the calf's head, which usually can be done when it is but three or four days old. * * *

In our tests in several instances the fluid was applied to but one horn button, the other being left untreated. The effect usually was to entirely stop the growth

of one horn, while the other grew naturally. [In one instance] the side of the head to which the chemical was applied not only failed to develop the horn, but even the heavy base which grows out from the skull to support it.

Ergotism in cattle, M. STALKER (*Iowa Sta. Bul. No. 17, May, 1892, pp. 153–156*).—An account of a disastrous outbreak of ergotism among a heard of cattle which had been fed on hay made from wild rye affected with ergot.

DAIRYING.

E. W. ALLEN, *Editor*.

Hand power cream separators, C. L. PENNY (*Delaware Sta. Bul. No. 17, June, 1892, pp. 13, figs. 2*).

Synopsis.—Comparisons of the De Laval and 30-gallon Victoria hand separators showed that they skimmed about equally close and as close as the power machines, but that the Victoria required about twice as much power as the De Laval to skim the same quantity of milk.

Illustrated descriptions are given of the De Laval (Baby separator) and the Victoria hand separators. Tests were made to compare the relative merits of these machines as to (1) the amount of fat lost in the skim milk, (2) necessary speed, and (3) the power required for running. Both a 20-gallon and a 30-gallon Victoria separator were used.

The only comparison reported of the thoroughness of skimming was on a skim milk from the cold-setting process. From 59 pounds of this containing 0.45 pound of fat the De Laval separated 0.38 pound, and from 63 pounds of the same skim milk containing 49 pounds of fat the Victoria separated 0.42 pound of fat.

[Trials with different rates of speed] show that the speed recommended for each, viz, forty or forty-two revolutions of the crank for the De Laval, and forty-six or forty-eight for the Victoria, is as low as high efficiency will allow. * * * So far as loss of fat in the skim milk is concerned, it will appear that a considerably lower temperature than the one required by the manufacturers of the machines, viz, 85° to 90° F. will do no harm, so that milk might stand some time before separation and yet suffer no material loss in the skim milk. * * * In point of capacity the larger Victoria is about equal to the De Laval and the smaller Victoria a little over two thirds as large. * * * From a large number of actual tests made by two different methods, it was found that the De Laval requires 0.11 horse power, the smaller Victoria 0.17, and the larger 0.225. To run the De Laval for one hour it would require the energy of a ton weight falling 109 feet, 168 feet for the smaller Victoria, and 223 feet for the larger Victoria. Without regard to time, the smaller Victoria requires about two and one fifth times and the larger about twice as much power as the De Laval to skim the same quantity of milk. * * * The De Laval owes its advantage here to the twenty-seven tin rings inside its bowl. Without these rings, but under otherwise similar conditions, it leaves from seven to eight times as much fat in the skim milk as when running with the rings in the regular way.

The difference in the power required by these two kinds of separators, in view of their substantial equality in other respects will, it is believed, decide in favor of the De Laval. * * * It is doubtful if a man of but ordinary strength could easily

run either size of Victoria for an hour continuously. * * * If some other force than man power be used the rather wide difference between the two makes of machine disappears.

The author questions the advisability of using hand power for separating milk. "To take an hour's time of an able man morning and night to do something that a horse will do equally well is a waste of resources."

Regarding the profit from the use of the separator, it is calculated that with a herd averaging 100 pounds of milk morning and night the year through, the separator would save about 280 pounds of butter in the year, which at 25 cents per pound would be a gain of $70 over cold setting; "but if fair wages be counted for the hand labor the profit would be much reduced if not wiped out."

The conclusions reached are chiefly these:

(1) The De Laval and Victoria hand separators tested skim about equally close and as close as the steam power machines.

(2) A lower speed than forty turns for the De Laval and forty-six for the Victoria is not efficient.

(3) The Victoria machines require about twice as much power to skim the same quantity of milk as the De Laval.

(4) The milk should have a temperature above 70° F. to prevent clogging.

(5) The use of hand power is not to be recommended.

The creamery industry, N. E. WILSON (*Nevada Sta. Bul. No. 16, April, 1892, pp. 66, figs. 36*).—This popular bulletin treats of the nature, formation, quality, and fermentative changes of milk; the objects, benefits, and management of coöperative creameries; creamery and dairy apparatus, including illustrated descriptions of separators, cream vats, churns, and butter workers; milk testing, with an illustrated description of the Babcock test; the relative value plan of paying for milk at creameries; and the testing of milk by composite samples; and gives plans and specifications for a creamery building which with outfit is estimated to cost about $2,000. No trials with the various machines are reported.

"The great interest that is now being manifested by the farmers and others of this State in the creamery industry, and the demand for information concerning all branches of the same, has prompted the preparation of this bulletin."

The estimation of the total solids in milk from the per cent of fat and the specific gravity of the milk, S. M. BABCOCK (*Wisconsin Sta. Report for 1891, pp. 292–307*).—The introduction of simple rapid tests of the fat in milk has given a special interest to the formulas proposed for calculating the percentage of solids and of solids-not-fat from the specific gravity and fat. By means of these two simple determinations and the use of a formula "an approximately accurate judgment concerning the composition of any milk may be obtained without the use of a chemical balance and in a much shorter time than would be required for obtaining the total solids alone."

The Fleischmann formula is

$$t = 1.2\,f + 2.665\,\frac{100\,S - 100}{S}$$

in which t = per cent of total solids, f = per cent of fat in milk, and S = specific gravity of milk at 15° C.

The author has calculated the per cent of solids not-fat corresponding to lactometer readings from 17° to 40° with from 0 to 6 per cent of fat, by means of the formula

$$\text{Solids-not-fat} = \left(\frac{100\,S - Sf}{100 - 1.0753\,S} - 1\right) \times (100 - f)\,2.6$$

in which S = specific gravity of milk at 60° F. and f = per cent of fat.

The results of these calculations are given in a set of tables. A simple formula, which can be used without tables, is

$$\text{Solids-not-fat} = \frac{L + 0.7\,f}{3.8} \text{ and}$$

$$\text{Total solids} = \frac{L + 0.7\,f}{3.8} + f$$

in which L = reading of Quevenne lactometer at 60° F. and f = per cent of fat.

In other words, "add the Quevenne lactometer reading at 60° F. to seven tenths of the per cent of fat and divide the sum by 3.8. The result will be the solids-not-fat, and this added to the per cent of fat gives the per cent of total solids." This formula is said to give quite accurate results with milk containing from 3 to 4 per cent of fat. Above these limits the results are too low and below too high, but the error will not amount to 0.1 per cent in either case and may be corrected by a method explained. "For ordinary purposes no correction need be applied." The accuracy of the formula is but slightly affected by simplifying to

$$\text{Solids-not-fat} = \frac{L + f}{4}$$

The results for average herd milk will be within 0.1 per cent of those of the more elaborate formula.

The method of deriving the formulas given above is thus described by the author:

It is assumed that milk is a mechanical mixture of two constituents, viz, milk serum, which is an aqueous solution of all of the solids of the milk except fat, and butter fat, which is suspended in very small particles in the milk serum, forming an emulsion with it. Such being the case the specific gravity of the milk will depend upon the specific gravity and relative amount of each of these constituents which the milk contains. The specific gravity of butter fat is practically the same in all milk, the variation being so slight that it does not materially affect results in investigations of this kind. On the other hand the specific gravity of milk serum is not constant, but depends upon the amount of solids which it contains in solution. Its specific gravity can never fall below 1, the specific gravity of water, and rarely exceeds 1.04; in normal milk it usually falls between 1.03 and 1.04. The difference between the specific gravity of water and that of milk serum is nearly in direct proportion to the solids which the serum contains. If, therefore, this difference

be divided by a constant factor which represents the increase in specific gravity caused by 1 per cent of serum solids, the result will be the per cent of solids in the serum. If the per cent of solids in the serum, found in this way, be multiplied by the per cent of serum in the milk considered and the product divided by 100, the result will be the per cent of solids-not-fat in this milk.

For convenience I shall represent the necessary factors in the following manner:

f = Per cent of fat in any milk.
$100 - f$ = Per cent of serum in any milk.
S = Specific gravity of milk at 60° F.
0.93 = Specific gravity of butter fat at 60° F.
x = Specific gravity of serum at 60° F.
a = Increase in the specific gravity of the serum caused by 1 per cent of serum solids.

Then in accordance with what has been said above,

$$(1)\quad \text{Per cent of solids-not-fat in any milk} = \frac{x-1}{a} \times \frac{100-f}{100}$$

It remains to find the value of x in terms of S and f and to determine from a large number of analyses the numerical value of the constant a.

The volume of a substance in cubic centimeters is equal to its weight in grams divided by its specific gravity; therefore

$$\frac{100}{S} = \text{Volume in c. c. of 100 grams of milk;}$$

$$\frac{100-f}{x} = \text{Volume in c. c. of serum in 100 grams of milk;}$$

$$\frac{f}{0.93} = 1.0753\,f = \text{Volume in c. c. of fat in 100 grams of milk;}$$

and as the volume of the milk is equal to the sum of the volumes of the fat and serum

$$\frac{100}{S} = \frac{100-f}{x} + 1.0753\,f$$

Clearing of fractions and reducing gives:

$$(2)\quad x = \frac{100\,S - S\,f}{100 - 1.0753\,S\,f}$$

The constant (a) is determined from the average of a large number of analyses of milk by first finding the value of x in equation 2, subtracting 1 from this, and dividing the remainder by the per cent of solids which the serum contains. The per cent of solids in the serum is found by dividing the per cent of solids-not-fat in the milk by the per cent of serum (100-f) and multiplying the quotient by 100.

The following table gives the data from which the value of (a) has been determined:

Average analyses of milk.

	No. of analyses.	Specific gravity.	Total solids.	Fat.	Specific gravity serum (x).	Solids in serum.	(a)
			Per cent.	*Per cent.*		*Per cent.*	
Jersey cow Jem	153	1.0312	15.885	6.34	1.03885	10.190	0.003812
Jersey cow Meg	117	1.0326	14.365	4.925	1.03854	9.929	0.003882
Herd milk (Jersey)	94	1.0315	14.470	5.090	1.03758	9.883	0.003802
Analyses from which Fleischmann's formula was derived	104	1.0312	11.953	3.242	1.03498	9.003	0.003885

The milks included in the above averages ranged from under 3 to over 8 per cent, and the value of a derived from them is believed to be approximately correct. Giving each series of analyses the same weight and taking the average of values found gives

$$a = 0.003815$$

and substituting the value of x and a in equation 1 and reducing gives,

$$(3)\ \text{Solids-not-fat} = \left(\frac{100\,S - Sf}{100 - 1.0753\,Sf} - 1 \right) \times (100 - f) \times 2.6$$

The more simple expression,

$$\text{Solids-not-fat} = \frac{L + 0.7\,f.}{3.8}$$

is derived in the following manner: It is assumed, as in the derivation of the preceding formula, that milk is a mechanical mixture of milk serum and fat; that the Quevenne lactometer reading, corresponding to the specific gravity of the milk serum, varies directly as the amount of solids in the serum; and that the lactometer reading for any milk depends upon the relative amounts of serum and fat which it contains. The factors common to the two formulas are designated in the manner already described; the additional factors are as follows:

L = Quevenne lactometer reading for any milk at 60° F.
y = Quevenne lactometer reading for serum of any milk at 60° F.
f′ = Volume per cent of fat in any milk.
a′ = A constant factor.

The reading of the Quevenne lactometer corresponding to any specific gravity is equivalent to 1,000 sp. gr. —1,000, and consequently the lactometer reading for pure butter fat, having a specific gravity of 0.93, is —70. The lactometer reading for mixtures of milk serum and fat, such as occur in milk, must lie between y, the reading for pure serum, and —70, the reading for pure fat, and will approach the latter figure directly as the proportion of fat increases. Starting with pure serum and increasing the proportion of fat until the serum is entirely replaced, the total range of lactometer degrees passed over will be represented by the difference between y and —70, or as y is always greater than 1, by y + 70. As lactometer readings depend upon the relative weights of equal volumes of the substance considered, this difference, y + 70, will represent the change in lactometer degrees caused by 100 volume per cent of fat and the effect of 1 volume per cent of fat will be

$$\frac{y + 70}{100}$$

This expression multiplied by the volume per cent of fat (f′) in any milk gives

$$\frac{y + 70}{100} f',$$

which is the difference in lactometer degrees between the reading for any milk (L) and the reading for the serum of that milk (y) and because L is always less than y,

$$y = L + \frac{y + 70}{100} f'$$

and by reducing

$$y = \frac{100\,L + 70\,f}{100 - f'}.$$

If this expression for the lactometer reading be divided by a constant number (a′) which represents the change in lactometer reading caused by 1 per cent of serum

solids, the result will be the per cent of solids in the serum. Introducing this factor the formula becomes

$$\text{Per cent of solids in the serum of any milk} = \frac{100\ L + 70\ f'}{(100 - f')\ a'}$$

This is only correct for volume per cents of fat. If, however, it be assumed that the volume and weight per cents are equal and the value of the constant a', in the above formula be determined, on this basis, from the average of a large number of analyses of milk, the expression will be correct for weight per cent for all milks containing this average per cent of fat. Moreover, as the ratio of volume per cent to weight per cent is small and the extreme limits for fat differ but a few per cent from the average, it is approximately true for all milks. The value of a' derived in this way from the average of the analyses upon which the general formula given above is based, is approximately 3.8. If this value be substituted for a' in the last equation considering $f' = f$ and the expression be multiplied by the per cent of serum (100 — f) and divided by 100 the result will be the per cent of solids-not-fat in the milk, or

$$\text{Solids-not-fat} = \frac{100\ L + 70\ f}{(100 - f)\ 3.8} \times \frac{100 - f}{100}$$

and by reducing

$$\text{Solids-not-fat} = \frac{L + 0.7\ f}{3.8}$$

in which L = Quevenne lactometer reading and f = per cent of fat.

The method of taking the specific gravity of milk and the precautions to be observed are described. With the lactometer most generally used "when milk is skimmed it will give a higher reading upon the lactometer than it did before the cream was removed and the addition of cream to milk affects the reading in the same way as the addition of water." For this reason, and on account of the ease with which the readings are transposed to specific gravity, the author prefers the Quevenne lactometer.

The scale of this lactometer expresses in thousandths the difference between the specific gravity of the liquid tested and water, the specific gravity of water being 1. In other words the reading of this lactometer is equal to the specific gravity of the milk in which it is placed, less 1 multiplied by 1,000. To illustrate, milk having a specific gravity of 1.0325 would give with this lactometer a reading of 32.5, and on the other hand a reading of 33 on this lactometer corresponds to a specific gravity of 1.033. * * * The scale of the ordinary lactometer may be converted into the Quevenne scale by multiplying by 20.

The reading of the Quevenne lactometer may by corrected for temperature without serious error (within 10) by adding 0.1 for each degree above and subtracting 0.1 for each degree below 60° F.

Detection of adulterations in milk, S. M. BABCOCK (*Wisconsin Sta. Bul. No. 31, April, 1892, pp. 17–27*).

In Wisconsin the legal standard for fat is 3 per cent, which is as low as any accepted standard in this country or Europe. In other States the standard ranges from 3 to 3.5 per cent. The general average for all breeds and for all seasons of the year is about 3.6 per cent of fat, and it is rare for the mixed milk from any herd to fall below 3 per cent. It is possible that the milk from individual cows or from herds which contain only two or three cows may contain less than the standard

demands, but usually milk with less than 3 per cent of fat has been either watered or skimmed.

The legal standards for solids-not-fat established in England and in some of the Eastern States is 9 per cent. In Wisconsin there is no legal standard for solids-not-fat. Milk containing less than 9 per cent of solids-not-fat is suspicious, and that containing less than 8.5 is probably watered.

An article on the use of the lactometer for determining the specific gravity of milk and on the calculation of the percentage of solids in milk from the specific gravity and the fat, is reprinted from the Annual Report of the station for 1891, pp. 292–307, reported above.

Notes on the Babcock test, S. M. BABCOCK (*Wisconsin Sta. Bul. No. 31, April, 1892, pp. 3–16*).—This test was first described in Bulletin No. 24 of the Wisconsin Station (E. S. R., vol. II, p. 256). The calls for the bulletin have been so numerous that the edition is nearly exhausted, and for this reason a description of the test is repeated, with some additional precautions and suggestions for its use.

In purchasing apparatus for this test be sure to obtain pipettes containing 17.6 c. c. This precaution is necessary as pipettes of several different sizes have been furnished with this test. This has usually been done on the plea that the larger pipettes give readings which will agree with the butter yield from the churn. This, however, is not the case and can not be accomplished by any test, as the yield of butter depends so largely upon the skill of the dairyman. The test is designed to show the amount of pure butter fat in the milk, and not the butter which will be made from it. * * *

[The sampling of milk at factories] may be accomplished in several ways, one of the following being recommended: By stirring the milk with a long-handled dipper after it has been poured into the weigh can and dipping out a small portion from which the test sample is measured; by inserting a small tube in the bottom of the conductor pipe, through which a small portion of the milk continually escapes and is caught in a vessel placed to receive it. The same end may be attained by laying a small tube in the bottom of the conductor pipe, having it project a foot or more beyond the end, and placing a small vessel to receive the portion of milk which runs through the tube. Samples may also be taken with the "milk thief," which is a tube, with a valve at the lower end, that is lowered into the milk in the weigh can, taking a column of milk from the top to the bottom of the can. A representative sample may be taken by any of these methods, but my preference is for one of the first three mentioned. * * *

[In testing cream] the necessity of dividing the sample of cream may be avoided by the use of a special test bottle devised by Mr. J. M. Bartlett of the Maine Station [Bulletin No. 3; E. S. R., vol. III, p. 397]. This bottle differs from the regular test bottles in having a bulb blown in the neck, the graduation commencing below the bulb, which holds 10 per cent. With this bottle cream up to 23 or 25 per cent of fat may be tested in the same manner as milk. * * *

Cream may be tested in the ordinary bottles in the manner proposed by Mr. Winton in Bulletin 108 of the Connecticut State Station [E. S. R., vol. III, p. 141], by using a pipette having a capacity of 6.04 c. c., which will deliver about 6 grams of average cream or one third of the weight of the usual sample. When this pipette is used about 12 c. c. of water should be added to the cream in the bottle before adding the acid. The usual amount of acid should be taken and the test completed in exactly the same way as with milk. The reading should be multiplied by 3 to obtain the per cent of fat in the cream. No correction for the specific gravity is necessary when this pipette is used. With either of these modifications the test may with advantage replace the oil test churn in gathered cream factories. * * *

With rich cheese the errors incident to sampling, to imperfect graduation of the tubes, and to incorrect measurements of the column of fat are multiplied by so large a factor that duplicate determinations with the same cheese often vary more than 1 per cent, so that the results with such cheese are only approximate. With cheese containing less than 20 per cent of fat the results are quite satisfactory.

The sources of error, when the test is applied to the examination of butter, are so large, owing to the high per cent of fat which butter contains, that the method is not recommended for this purpose.

A description is given of the principle and the practical workings of the relative value plan of paying for milk, and of the method of testing milk by means of composite samples, as suggested by G. E. Patrick in Bulletin No. 9 of the Iowa Station (E. S. R., vol. II, p. 101), together with the use of powdered lye for dissolving the curd in soured composite samples instead of a preservative to prevent souring, as suggested by E. H. Farrington in Bulletin No. 16 of the Illinois Station (E. S. R., vol. III, p. 150).

A very satisfactory composite test may be made without the trouble of dissolving the curd, by using a test bottle of twice the usual size, such as is recommended for skim milk, for each patron and measuring into this with a 5 c. c. pipette, a sample of his milk each day for seven days. The bottle will then contain double the usual test sample, and by adding double the usual amount of acid the test may be completed as with fresh milk. It is well to shake up the contents of the bottle before adding the acid. The reading should be divided by 2 for the per cent of fat. A composite test for three days can be obtained in this way in the ordinary test bottles by using a pipette containing 5.9 c. c., making the test in just the same way as with fresh milk.

The objections to this method are that more care is required in taking the daily samples, and in case of accident in making the test the record for the time covered by the composite sample, is lost. The result is accurate and the time required less than by any other method.

Creaming experiments, S. M. BABCOCK (*Wisconsin Sta. Report for 1891, pp. 69–90*).—An account of these experiments was printed in Bulletin No. 29 of the station (E. S. R., vol. III, p. 480).

TECHNOLOGY.

Results of the bounty on maple sugar, W. W. COOKE and J. L. HILLS (*Vermont Sta. Bul. No. 30, June 1, 1892, pp. 7*).—According to the Census of 1890, there was produced in Vermont in the spring of 1889, 14,123,921 pounds of maple sugar, valued at $1,081,899, at 7.7 cents per pound; and 218,252 gallons of maple sirup, valued at $166,457, at 76.5 cents per gallon. The total number of sugar producers in the State was 14,337, of whom 10,099 produced 500 pounds or more. From the returns in the office of the United States collector of internal revenue it appears—

That 2,328,846 pounds of sugar were weighed and sampled this year for the bounty, of which 82,237 pounds, or 3½ per cent, tested 90° or over and is entitled to a bounty

of 2 cents a pound; 1,939,339 pounds, or 83¾ per cent, tested from 80° to 90° and is entitled to a bounty of 1¾ cents a pound; while 307,270 pounds tested under 80° and will get no bounty. In general terms, then, seven eighths of the sugar tested will get the bounty. The law requires that at least 500 pounds, testing 80° or over, shall be produced to get the bounty. In the total quantities given above are included 522 pounds testing 90° or over and 27,306 pounds testing 80° to 90° that were in quantities of less than 500 pounds per person and hence lose the bounty. So that there remains 81,715 pounds at 2 cents per pound valued at $1,631.30, and 1,912,033 pounds at 1¾ cents per pound valued at $33,460.58, a total bounty for Vermont of $35,091.88.

Of the 2,609 persons who took out a license in 1891, 1,918 tried to get the bounty, but 247 failed. The 1,617 persons who obtained the bounty received on the average $21.70. The crop was a small one, being only 60 per cent of the average amount. It appears that it was somewhat more profitable to make sirup rather than sugar, even when the bounty was obtained for the latter. The authors, however, believe that the results from the bounty are sufficiently satisfactory to warrant the taking out of licenses by a greater number of sugar makers. The Government regulations regarding the issuing of licenses are given in the bulletin.

AGRICULTURAL ENGINEERING.

The station sheep barn, L. H. ADAMS (*Wisconsin Sta. Report for 1891, pp. 280–288, figs. 7*).—"The building consists of a main part 24 by 30 feet, two stories high, under the whole of which is a root cellar, and two wings reaching off at right angles from it. The east wing is 125 feet long, 18 feet wide, and one story high."

The plan of the building is described in some detail, with illustrations. Especial attention has been paid to securing ample ventilation.

Each pen has double doors, which when opened out into the yard make an opening that only lacks 38 inches of being as wide as the pen. One door is bolted securely at the top and bottom by bolts operated by a lever, and the other one fastened to it by means of an ordinary thumb latch so that one or both doors may be opened at will. A slight upward movement of the lever allows both doors to swing open and when pushed shut a similar downward movement locks them safely.

Over these double doors are windows that are the same width as the doors and 2 feet high. These windows are hinged at the top and are opened and closed from the passageway by means of a rope that runs over two small pulleys. The windows are provided with a fastening device that works automatically. A pull on the rope from the passageway unlocks the window and raises it up at the same time. When the rope is released the window closes and locks itself. Since the windows are operated from the alleyway time is saved and annoyance and confusion to the sheep prevented. * * *

Should it become necessary to close the barn tight we still have ventilation by means of shafts that are constantly carrying off air from near the floor of each pen. These shafts are simple wooden boxes that start a foot from the floor and extend up through the roof as high as the peak. They are made by nailing two 8-inch and two 10-inch boards together. Near the bottom on one side of the shaft is an opening for the admission of air, the flow of which can be regulated by a door that is hinged at the bottom and pushes into the shaft.

STATION STATISTICS.

Fourth Annual Report of Kansas Station (*Kansas Sta. Report for 1891, pp. 26*).—This includes a financial statement for the fiscal year ending June 30, 1891, abstracts of Bulletins Nos. 20–32, brief statements regarding work of the station not reported in bulletins, an account of changes in the station staff during 1891, a list of station publications issued prior to 1891, and an index to the station publications for 1891.

Report of the North Louisiana Station for 1891, J. G. LEE (*Louisiana Sta. Bul. No. 16, 2d ser., pp. 428–435*).—This includes a brief review of the work of the year, a list of the fruit trees in the orchard and of the live stock at the station, a report on the station buildings, and brief mention of experiments to be undertaken by the station in tobacco-growing.

Fifth Annual Report of Nebraska Station (*Nebraska Sta. Report for 1891, pp. 251, plates 3, figs. 32*).—This includes a brief résumé of the work of each department of the station; a subject list of the publications of the station; a financial statement for the fiscal year ending June 30, 1891; the text of the act of Congress of March 2, 1887, and of the act of the State legislature approved March 31, 1887, assenting to the act of Congress; and reprints of Bulletins Nos. 16–20 of the station, abstracts of which may be found in volume III of the Record.

Station work in progress, J. C. NEAL (*Oklahoma Sta. Bul. No. 2, March, 1892, pp. 20*).—A brief description of the station farm and buildings; statements regarding the cultivation of the land; and lists of varieties of grasses, forage plants, corn, orchard and small fruits, and grapes, with which experiments are to be made.

Report of director of Wisconsin Station, W. A. HENRY (*Wisconsin Sta. Report for 1891, pp. 4, plate 1*).—Brief general statements are made regarding the work of the station. The importance of raising greater numbers of sheep for mutton in Wisconsin is strongly urged. The new dairy school building is illustrated. The desirability of confining the work of individual stations to a few lines of investigation and of making the tenure of station officers permanent is emphasized.

Financial statement (*Wisconsin Sta. Report for 1891, p. 319*).—This is for the fiscal year ending June 30, 1891.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Climate and meteorology of Death Valley, California, M. W. HARRINGTON (*Weather Bureau, Bul. No. 1, pp. 50, figs. 10*).—An account of observations during five months (May–September) of 1891, made in connection with an exploration of the valley under the direction of C. H. Merriam of this Department, with the coöperation of the Geological Survey and the Signal Service, continued by the Weather Bureau. The physical features of the valley are described, as well as the meteorological station and the instruments used, and the observations taken are tabulated and discussed.

The southwestern corner of the arid region of the West is occupied by the Colorado and Mohave Deserts, the latter the northern and more extensive of the two. The northern margin of the Mohave Desert reaches out into narrow valleys between bold ridges of mountains which run nearly north and south. These valleys are usually shallow, but a few are characterized by great depth. The most remarkable of these is Death Valley, in that its bottom is said to descend below sea level, while it is about 200 miles from the coast, and between it and the latter intervene the lofty Sierra Nevada Mountains. This valley is said to owe its name to the melancholy fate of a party of immigrants who, about 1850, perished from thirst within its limits.

Death Valley lies between the brilliantly colored Funeral and Amargosa ranges of mountains, reaching an elevation of 5,000 to 6,000 feet on the east, and the Panamint Mountains on the west. The latter reach an elevation of 8,000 to 9,000 feet, and culminate opposite the middle of the lower valley in Telescope Peak, said to be 10,938 feet high. The valley is an independent drainage basin, nearly closed on the south by a rapidly rising edge about 2,000 feet high. The southern part, into which pours the catch of the entire basin and that of the entire Amargosa Valley on the east, is nearly level, and it is to this portion that the name of Death Valley is applied. * * * Death Valley proper lies between latitudes 35° 40′ and 36° 35′ north, and longitudes 116° 15′ and 117° 5′ west from Greenwich. It is directly east from Tulare and Owens Lakes, about 50 miles from the latter, and the boundary between Nevada and California runs not far east of its eastern margin. It is about 75 miles long, with an axis running nearly northwest and southeast. The width from crest to crest is from 20 to 25 miles, but the bottom is only 12 or 15 miles wide at its widest point; opposite the meteorological station it is about 6 miles wide. * * *

The principal features of popular interest in Death Valley are its excessive heat and dryness. The temperature rises occasionally in the shade to 122°, rarely falls at any time in the five hot months below 70°, and averages 91°. It is not only hot in summer but consistently hot, and the heat is increased by occasional hot blasts from the desert to the south. The air is not stagnant, but in unusually active motion. Gales of a few hours' duration are very common, and sometimes they produce sand whirls and sand storms. The heat and movement of the air together make this a

very dry—an arid—place and this aridity in summer is almost as consistent as the heat. Rains may fall frequently in the mountains and occasionally in the valley, clouds are by no means lacking, and water can probably always be found at the depth of a few feet in the soil, yet the heat and wind together keep the surface very dry and the relative humidity low. Animal and plant forms are comparatively few, and the former are usually nocturnal, to avoid the heat.

Both heat and aridity are increased by the character of the valley. It is narrow and deep, apparently the bed of an old sea, inclosed by high and bare mountains. The white and shifting sands become much heated under the noonday sun; the rest of the surface is in part salt and alkali, in part pebbly wash from the mountains, and in part a loose spongy earth, over which it is difficult to move. With the exception of a few springs, the water is bitter and unwholesome. * * *

The meteorological features of interest lie for the most part in those modifications of diurnal changes which are due to the topography. The range of temperature is usually great; the hourly progress of the winds show curious changes in speed, in direction, and in temperature. The diurnal change in the barometer is the most characteristic of the form found in continental valleys. It is of the purest single maximum type and has the largest amplitude known. With these features go those sharp thunderstorms, limited to certain hours of the day, and daily gales and hot blasts.

It is also noteworthy that the absolute humidity here is fairly constant, and is that belonging to that part of the world. The air in the valley is part of the general aërial ocean, and this shows no sharp contrasts in its moisture content, except where wind prevails across a mountain ridge. Here the prevailing winds are up and down the valley, and its relative aridity is due to its higher temperature. * * *

[In the following table a comparison is made of the climatic conditions of Death Valley and of several localities in India and the Sahara Desert for the hottest month of the year in each place.] All these places are celebrated for their great dryness and excessively hot summers.

Comparison of Death Valley and other stations.

Stations.	Month of greatest heat.	Mean temperature.	Absolute maximum.	Mean maximum.	Mean minimum.	Mean daily range.	Relative humidity.	Cloudiness.	Rainfall.	No. of rainy days.	Elevation.	Years of observation.
		°	°	°	°	°	Pr. ct.		Inch.		Feet.	
Death Valley, California.	July.	102.1	122.0	115.6	86.8	29	20	31	0.13	0.37	.....	*1
Sinde:												
Hyderabad	May.	91.0	121.0	106.0	78.0	28	45	7	0.10	1.00	94	8
Jacobabad	June	96.0	122.2	111.0	83.0	28	42	11	0.10	1.00	186	9
Punjaub:												
Dera Ismail Kahn ..	June	93.0	121.5	107.0	80.0	27	44	16	0.60	2.00	573	11
Mooltan	June	94.0	118.4	107.0	82.0	25	51	10	0.40	2.00	420	11
Tunisian Sahara (lat. 30° 35′):												
Gardaia	July.	96.0	118.4	111.0	78.0	29	25	7	0.08	1.00	706	†1

*Date of observation, 1891. †Date of observation, 1887.

Notes on a new method for the discussion of magnetic observations, F. H. BIGELOW (*Weather Bureau, Bul. No. 2, pp. 40, fig. 1*).—This is a preliminary statement of some new devices adopted in the discussion of magnetic observations, whereby it is hoped that these may be forced to yield more information regarding the physical causes that produce the periodic and the spasmodic fluctuations of the magnetic needle. The method is differential, and consists in deriving a succession

of residual values in three coördinates, the system assumed being rectangular—X in the mean magnetic meridian to the north, Y to the west, Z normal to the plane of the horizon and counted positive downwards. These are then transformed into polar coördinates, S the total force, of which the residuals are the components, acting in a plane making an angle β with the magnetic meridian and an angle α in this plane with the plane of the horizon. In order to facilitate an understanding of the very complicated system of deflecting forces that surround the earth, these polar coördinates are plotted on a globe at the local hour angles of the station referred to the sun, at which the forces themselves are effective, and thus are built up and made simultaneously visible to the eye the magnetic forces which are deflecting the normal field at any instant of time. The paper before us gives only an outline of this process and a running example to illustrate specifically the treatment of the observations as contained in the reports of magnetic observations, and therefore no final conclusions are stated. An outline, however, is given of the physical conditions that seem sufficient to account for the various deflecting fields that can be detected. These are generally (1) the annual field, (2) the diurnal field, (3) the disturbance fields, and (4) the meteorological field. Prof. Bigelow advances the theory that the energy from the sun, all these deflecting forces being derived from its action propagated through the intervening space, comes to the earth along two principal fields, (1) the radiant field parallel to the ecliptic, and (2) the coronal field perpendicular to the ecliptic, this being the extension of such wide-sweeping lines as proceed from the sun regarded as an electro-magnetic polarized body, and of which the coronal streamers are a visible portion. Ordinary radiant sunlight is magnetic as well as electric, in accordance with Maxwell's theory of the propagation of light, and when it arrives at the earth, which is a magnetic polarized sphere, the rays are bent out of the straight course into a series of peculiar curves as they enter, pass through, and recede from the earth. Some thirty stations, where continuous twenty-four hourly observations have been maintained through one year at least, are being computed at the Weather Bureau, and thus the whole complex annual and diurnal fields will be mapped out ready for description and discussion.

In a similar manner the magnetic disturbances, which sometimes amount to storms, can be discussed, and this problem is also well in hand so far as the reductions are concerned. Prof. Bigelow points out and illustrates in this bulletin that these disturbances may be referred, so far as is now known, to either the coronal or to the radiant field. In either case, whenever the sun's energy goes through any sudden change in its manifestations, there is a corresponding variation produced throughout all the ether that surrounds it as far as light can penetrate, and this propagation is felt at the earth in either the radiant or the coronal fields, or in both, producing changes in the point-

ing of the needle. The radiant field is much stronger than the coronal field when things are in their normal conditions, but during disturbances the coronal field may be strengthened and superposed upon the radiant field, or the radiant field may be strengthened. In every case the effect is to spread the polar field surrounding the magnetic poles and which properly extends only to the auroral belt, down over the mid-latitude regions, for the time being displacing the forces which ordinarily are in action there. An example of the traces during the storm of June 5, 1892, is given, together with the computation and the resulting forces on the model for twelve hours, from noon to midnight.

There is still a broad line of investigation, which has made progress at the Weather Bureau, and which is a necessary outgrowth of the theory thus explained. It is the modifications introduced into these fields by the presence of the atmosphere, together with its ever fluctuating influence as indicated by the meteorological elements. If magnetic forces are in fact a part of the radiant sunlight, then it follows that any causes which modify the quality of the light received must also modify the magnetic field associated with it. No attempt is made in the bulletin to indicate precisely what the physical conditions are that are thus concerned, though it is evident that aqueous vapor under varying pressures and temperatures is the principal agent, only an outline of the processes of discussion being mentioned. Prof. Bigelow feels able to state that such a connection seems to exist, and that from several independent lines of approach the testimony in favor of this conclusion is steady and persistent. The irregularities in the magnetic traces all have some effective physical cause, and it is hoped by the method of exhaustion, that is, by treating fully all the well known and strong residuals, to finally reach the smaller but no less important terms involved in the action of the atmosphere. Finally, the auroral problem will no doubt come to a solution along with the others just described.

The object of the bulletin is to open up the field of research and to describe the process of the discussion, so far as practicable, but at the same time it is implied that the research is most promising in the results already attained, and that the development can hardly fail to be far-reaching in its final conclusions.

The fermentations of milk, H. W. CONN (*Office of Experiment Stations, Experiment Sta. Bul. No. 9, pp. 75*).—In this treatise the term fermentations is used to cover not only the souring of milk and the alcoholic fermentations, but all of the changes induced by rennet, yeasts, bacteria, and unorganized ferments. In an introduction the nature and composition of milk are described. The fermentations are treated under the headings: Fermentations by rennet, souring of milk, number of bacteria in milk, relation of electricity to souring, alkaline fermentations, butyric acid fermentation, bitter milk, alkaline curdling of milk and the peptonizing power, blue milk, alcoholic fermentations, slimy milk, and miscellaneous fermentations. In each case the litera-

ture of the subject is reviewed, and a summary given of the present state of knowledge on the subject. In conclusion, the practical bearings of the subject on the handling of milk, butter making, and cheese-making are considered.

Our study of milk and fermentation has taught us first of all that all fermentations of milk, even the common souring, are due to the contamination of the milk with something from the exterior after it is drawn from the cow. If they are thus all due to contaminations from without, all that is needed to prevent them is to treat the milk in such a way that no such contamination is permitted. * * * This has been shown to be accomplished best by two precautions, absolute cleanliness and low temperatures. The great source of these organisms is in the unclean vessels in which the milk is drawn and in the filth which surrounds the cow. By scrupulous cleanliness in the barn and dairy the number of organisms which get into the milk may be kept comparatively small.

Of equal value in preserving milk is the use of low temperature, and to be of the most use it should be applied immediately after the milk is drawn. When drawn from the cow milk is at a high temperature, and indeed at just the temperature at which most bacteria will grow the most rapidly. * * * If, however, the milk is cooled to a low temperature immediately after it is drawn, the bacteria growth is checked at once and will not begin again with much rapidity until the milk has become warmed once more. This warming will take place slowly, and therefore the cooled milk will remain sweet many hours longer than that which is not cooled. * * * A second lesson of no less importance has been taught. All of the abnormal fermentations of milk, such as blue milk, red milk, slimy milk, tainted milk, etc., are also due to the growth of organisms in the milk, and all of these are preventable by care. While the lactic organisms are so common and so abundant as to make it hopeless to try to keep them out of the milk, this is not true of the organisms producing the abnormal fermentations, and by the exercise of care they may all be prevented from getting into milk in such a way as to cause trouble. * * * The lessons for the dairyman to learn from the study of the fermentations of milk are, scrupulous cleanliness in all affairs relating to milk, care in the dairy, thorough washing with boiling water of all milk vessels, and low temperatures applied to milk immediately after it is drawn from the cow.

In butter-making and cheese-making certain forms of fermentation are beneficial, but here also mischievous organisms seriously affect quality and keeping properties. The employment of pure cultures of organisms in the ripening of cream and of cheese is described, and the prediction is ventured that possibly at no distant future both the butter maker and cheese maker will use the fresh milk directly.

The butter maker will separate the cream by the centrifugal machine in as fresh a condition as possible and will add to the cream an artificial ferment consisting of a pure culture of the proper bacteria, and then ripen his cream in the normal manner. The result will be uniformity. The cheese maker will in like manner inoculate fresh milk with an artificial ferment and thus be able to control his product. Perhaps he will have a large variety of such ferments, each of which will produce for him a definite quality of cheese. To the dairy interest, therefore, the bacteriologist holds out the hope of uniformity. The time will come when the butter maker will always make good butter and the cheese maker will be able in all cases to obtain exactly the kind of ripening that he desires.

Milk fermentations and their relations to dairying (*Office of Experiment Stations, Farmers' Bul. No. 9, pp. 24*).—A popular summary of Experiment Station Bulletin No. 9 (see above).

Organization lists of the agricultural experiment stations and agricultural schools and colleges in the United States (*Office of Experiment Stations, Experiment Sta. Bul. No. 12, June, 1892, pp. 78*).—This includes a list of the governing boards and working forces of the several stations; a list of the agricultural schools and colleges, with courses of study and boards of instruction; the officers of the Association of American Agricultural Colleges and Experiment Stations; officers and reporters of the Association of Official Agricultural Chemists of the United States; the texts of the acts of Congress of July 2, 1862, March 2, 1887, and August 30, 1890, relating to the colleges and stations; regulations of the Post Office Department relating to the use of the franking privilege by the stations; and an index of the names of station officers, with a short biographical sketch of each station worker.

Report of the area of corn, potatoes, and tobacco, and condition of growing crops (*Division of Statistics, Report No. 97, n. ser., July, 1892, pp. 217–272*).—"This report relates to the comparative acreage of corn, potatoes, and tobacco, and the condition on the first day of July of corn, winter and spring wheat, oats, rye, barley, potatoes, tobacco, the grasses, fruits, and other minor crops."

Reports of observations and experiments in the practical work of the Division of Entomology (*Division of Entomology, Bul. No. 26, pp. 95*).—This bulletin comprises the reports of the field agents of the Division for 1891.

Report upon insect depredations in Nebraska for 1891, L. Bruner (pp. 9–12).—A brief summary of the most prominent of the injurious insects of the year, exclusive of locusts and grasshoppers, a more extended account of which is published as Bulletin No. 27 of this Division (E. S. R., vol. III, p. 907). The species prevalent were, the corn root worm, green-striped maple worm, *Lyda* sp., and the gooseberry spanworm, and the following, mentioned as injuring the sugar beet: *Monoxia guttulata*, *Hippodamia convergens*, *Diabrotica vittata*, *D. longicornis*, and cutworms. The author reports success in the use of corn meal against cabbage worms, and calls attention to a new pest of cabbages, the larva of a Tenebrionid beetle, *Eleodes tricostata*.

Report on scale insects of California, D. W. Coquillett (pp. 13–35).—A somewhat detailed account of the season's work on California scale insects, including notes on their life history and habits, food plants, natural enemies, and accounts of experiments with various insecticides for these insects. The following species are considered: Red scale (*Aspidiotus aurantii*), convex scale (*A. convexus*), oleander scale (*A. nerii*), San José scale (*A. perniciosus*), greedy scale (*A rapax*), soft or brown scale (*Lecanium hesperidum*), hemispherical scale (*L. hemisphæricum*), black scale (*L. oleæ*), frosted scale (*L. pruinosum*), and brown apricot scale (*L.* sp). The report concludes with a short chapter on the use of thymo-cresol as an insecticide for scale insects.

Entomological notes for the season of 1891, M. E. Murtfeldt (pp.

36–44).—Notes on the woolly aphis of the apple, grain aphis (*Siphonophora avenæ*), joint worm (*Isosoma grande*), plum curculio, harlequin cabbage bug, *Orsodachna atra*, a new enemy to the peach, cottony maple scale, post oak coccid (*Chermes* sp.), white marked tussock moth, *Chamyris cerintha* (on plum), *Catocala grynea*, and *Edema albifrons*: some observations on the forest tent caterpillar in Minnesota; notes on some natural enemies of pernicious insects, and a chapter on the insecticidal properties of thymo-cresol.

Report of progress in the investigation of the cotton bollworm, F. W. Mally (pp. 45–56).—A brief summary of the work done during the season on the bollworm of cotton. The subject is treated under the following topics: Geographical distribution and destructiveness, food plants, characters and transformations, natural enemies, insect ravages easily mistaken for those of bollworm, and remedies. The great range of food plants of this insect and its habit of feeding in solitude rather than gregariously, render it a difficult species to control with insecticides. The most practical remedies are spring plowing to destroy the chrysalids, and the use of corn and cowpeas as trap crops. Poisoned sweets, pyrethrum, and trap lights are of little practical value, and experiments with infectious diseases have thus far produced only negative results.

Insects of the season in Iowa, H. Osborn (pp. 57–62).—The principal species treated are the white-winged bibio (*Bibio albipennis*), plant lice of various species, clover seed midge, clover seed caterpillar, *Apanteles glomeratus* (a parasite of the common cabbage worm), and the apple maggot. A brief summary of successful trials of the "hopper-dozer" plan for grass leaf hoppers is also given. In one experiment these insects were captured at the rate of 376,000 per acre.

Report of entomological work of the season of 1891, F. M. Webster (pp. 63–74).—This report is mainly an account of several species of crane flies infesting meadows and pastures, which may also prove injurious to wheat.

Report on the Gypsy moth in Massachusetts, S. Henshaw (pp. 75–82).—An account of the work being done by the State of Massachusetts to suppress the Gypsy moth (*Ocneria dispar*).

Copies of acts and resolutions passed by the legislature providing against depredations by this insect are given, together with a map showing the infested region. There are also notes on the habits of this insect, and a list of its food plants and of its natural enemies. The author criticises the plans adopted for the repression of this pest.

The attention drawn to this insect should lead to the passage of a general law against insect and fungous pests. A State officer acting under the direction of the board of agriculture could recommend to farmers and others the means to be used against noxious insects and fungi, and the law should be so framed that penalties could be imposed upon owners who took no precautions after due notice had been given. Some such legislation would soon bring the orchards and shade trees of

Massachusetts into a more creditable condition, and the introduction of the Ocneria could be looked upon as a benefit rather than an injury.

Report on apicultural experiments in 1891, A. J. Cook (pp. 83–92).—A report of a series of experiments in apiculture conducted during the season with the assistance of Mr. J. H. Larrabee. Planting for honey, spraying during fruit bloom, value of bees in effecting plant fertilization, secretion of wax, feeding of drones by workers, conductivity of wax, and winter protection are considered.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Ash content of etiolated leaves, W. PALLADIN (*Ber. deut. bot. Ges., 1892, p. 179*).—The author reports recent experiments which indicate that the ash content of etiolated leaves of wheat and vetch is noticeably lower than that of the green leaves of the same plants. For example, the ash content of green wheat leaves was 9.74 and 10.75, and of etiolated leaves 8.82 and 9.41; and of green vetch leaves 10.3 and etiolated 7.54. The difference is especially marked in case of the calcium. The fact that a similar diminution in ash content occurs when plants are grown in air saturated with moisture, that is, when the transpiration is hindered, and that the conditions of etiolation hindered the transpiration, indicates a connection between the transpiration of the leaves and the taking up of mineral ingredients.—E. W. A.

Earlier observations on the root tubercles of Leguminosæ, A. PRILLIEUX (*Compt. rend., 111 (1890), pp. 926, 927; abs. in Centralbl. agr. Chem., 21, p. 126*).—It is stated that Woronin in 1867 recognized in the root tubercles delicate organisms, capable of motion, which he regarded as bacteria. The author himself in 1879 studied the subject and found that the organisms in question might differ widely in form, and that the supposed motion was molecular or Brownian motion. He recognized the tubercles as abnormal formations and found that they could be induced by artificial inoculation.—E. W. A.

Reaction of sulphate of iron with the phosphates employed in agriculture, P. CAZENEUVE and A. NICOLLE (*Monit. scient., 1892, ser. 4, p. 334; abs. in Chem. Ztg., 1892, Repert., p. 173*).—The authors explain that many fertilizer manufacturers follow the practice of mixing green vitriol with their fertilizers, especially with the phosphates of lime. It was to study the effect, if any, which this admixture might have upon the solubility and availability of the phosphoric acid that the experiments reported below were made.

Sulphate of iron was moistened with water and mixed with superphosphate, citrate-soluble precipitated phosphate, di-calcium phosphate, bone phosphate, slag, and rock phosphate, in amounts ranging from 10 to 20 per cent. The mixtures were exposed to the air in thin layers for eight days. Determinations were made in each of the phosphoric acid soluble in water, in ammonium citrate, and in acetic acid before and after the treatment with the green vitriol. From the

results of these it was evident that the phosphoric acid in the slag, rock phosphate, and bone was not materially affected by the iron salt, but that the water soluble phosphoric acid in the superphosphate was noticeably diminished, and the solubility of the precipitated di-calcium phosphate increased. Thus, while 1 gram of the superphosphate contained 0.15 gram of water-soluble phosphoric acid before treatment, the amount was diminished to 0.06 and 0.02 gram, respectively, by treatment with 10 and 20 per cent of iron sulphate.

A sample of di-calcium phosphate containing 48.46 per cent of phosphoric acid, all soluble in ammonia citrate, contained only 1.93 per cent of acid after being heated at red heat. Both the original and the incinerated phosphate were treated with 10 per cent iron sulphate, after which the original contained 48.2 per cent and the incinerated 11.85 per cent of citrate-soluble acid. That is, the iron sulphate did not diminish the amount of reverted acid in the unheated phosphate, and partially restored the amount in the incinerated product.

A sample of precipitated tricalcic phosphate obtained from a druggist, containing originally 45.4 per cent phosphoric acid, all of which was insoluble in ammonium citrate, was found to contain 29.54 per cent of reverted acid after treatment for eight days with 20 per cent of iron sulphate. All these trials were made with free access of air. The failure of the iron sulphate to affect the tricalcic phosphate in bone, slag, and rock phosphate as noted above, the authors suggest may be due to a peculiar molecular arrangement in the case of these materials, which renders them resistant.

Theoretically this action of moist iron sulphate in the presence of air may be explained by the change of iron from a ferrous to a ferric salt, and the formation from that of a citrate soluble phosphate of iron.

The practical conclusions are, among others, that in mixing phosphate with sulphate of iron the iron salt should be ground alone before mixing and not with the phosphate, otherwise the solubility of the phosphate in water may be seriously affected.—E. W. A.

Experiments on the value of different plants for green manuring, V. STREBEL (*Abs. in Centralbl. agr. Chem., 21, pp. 235–238*).—These experiments were made in 1891 on the experimental fields at Hohenheim, Würtemberg. The soil was a heavy loam, on which rye and winter peas had been grown in 1888, rape manured with superphosphate and nitrate of soda in 1889, and winter barley in 1889–'90. After the barley was harvested seventeen different kinds of leguminous and other plants were sown for green manuring on 17 plats, each containing about 50 square yards separated by uncultivated strips. In September following the crop on each plat was spaded under and Sheriff wheat drilled on all the plats. The yield of wheat where different leguminous plants had been used as green manures (lupines, clovers, field beans, peas, vetch, and serradella) ranged from 14.81 to 22.37 pounds of grain per plat, averaging 19.62 pounds. It was lowest with serradella

and highest with red clover and white and yellow lupine. Second to the latter were field peas and beans, scarlet clover, and black medis. The yield with cole was 16 pounds, with white mustard 15.6 pounds, and with 3 varieties of buckwheat the average yield was 13 pounds per plat.

It was noticed that on the plats, especially those with lupines, many heads of grain were backward in ripening. On examination the roots of such plants were found to be covered with a white fungus. No such fungus was found on the roots where non-leguminous plants were used for green manure. In how far this occurrence was due to the green manuring with leguminous plants the author was unable to determine.

In another series of experiments the object was to compare the total amounts of nitrogen contained in crops of different leguminous plants, and in the leaves, stems, and roots of the same separately. The soil on which this trial was made had been in grain for three years previous. Whether or not it was manured in any way for the present crop is not stated in the abstract. The seed was broadcasted on the different plats. The results per square meter are given as follows:

Nitrogen in various leguminous crops per square meter of land.

Number of plat.	Kind of plants.	Weight of water-free crop—			Nitrogen in—		
		Stems and leaves.	Roots.	Whole plant.	Stems and leaves.	Roots.	Whole plants.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
1	White lupine	554.17	78.29	632.45	11.5267	1.3074	12.9041
2	Blue lupine	534.77	73.33	610.10	11.3371	1.1751	12.5122
3	Yellow lupine	325.23	74.70	400.93	9.3194	1.3222	10.6416
4	Field beans	555.04	70.69	625.73	16.2627	1.3572	17.6199
5	Red vetch	534.47	51.73	586.38	16.1999	0.6725	16.8721
6	Mixture of vetches	571.22	10.54	581.76	16.6245	0.2604	16.8849
7	Common vetch	486.44	36.74	523.18	15.5174	0.5842	16.1016
9	Crimson clover	519.80	46.60	614.40	12.8205	0.4986	13.3191
10	*Lathyrus magellanus*	587.77	54.61	637.58	16.0845	0.6499	16.7344
	Chickling vetch:						
11	German	574.81	31.39	606.20	17.5892	0.5022	18.0914
12	African	480.57	28.54	509.11	8.9356	0.2825	9.2211
13	Purple-red vetch	505.74	31.42	537.16	17.2457	0.4839	17.7296
16	Chickling vetch, German	560.93	35.49	596.42	15.7060	0.5536	16.2596
17	Large field beans	756.21	74.87	831.07	24.3499	1.3851	25.7350
18	Blue lupine (foreign seed)	615.75	46.17	661.92	18.5341	0.6233	19.1574
19	White lupine (foreign seed)	632.52	17.62	650.16	18.2166	0.2417	18.4583
21	Large sand vetch	510.95	7.63	518.58	11.0876	0.1351	11.2227
22	Sand vetch	418.31	31.29	449.60	12.9297	0.6665	14.5962

According to these figures the large field beans (plat 17) gave the largest yield of nitrogen per square meter of land, but considering the cost of seeding this crop the author believes that from a financial point of view it does not exceed the lupines in value. The difference in the nitrogen in the white and blue lupines raised from native and from foreign seed is very marked, the foreign seed yielding over a third more.

The author proposes to continue this line of experiment on a larger scale another year, leaving out some of the less promising crops.

[The above figures serve to show the extent to which crops of certain

leguminous plants may enrich the soil in nitrogen; and when it is remembered that under favorable conditions a part or the whole of this nitrogen may be derived from the atmosphere without material cost, the value of green manuring as a means of supplying the soil with this essential and most expensive plant food ingredients must be evident. A calculation of the amounts given above to an acre of land gives over 225 pounds of nitrogen as the amount contained in a crop of large field beans, about 165 pounds of nitrogen in the blue and white lupines (plats 18 and 19), etc. To supply these amounts of nitrogen in the form of nitrate of soda would require from 1,000 to 1,500 pounds of that material.]—E. W. A.

Rape culture, T. Shaw and C. A. Zavitz (*Ontario College Sta. Bul. No. 71, June 1, 1892, pp. 8*).—General statement regarding the culture and uses of rape, and brief notes on experiments at the station in the culture of this plant and in its use as a feeding stuff for lambs. Rape can be successfully grown in Ontario and quite generally in the Dominion of Canada. In the experience of the station flat cultivation in drills has given good results, nitrate of soda being the most effective fertilizer. The application of salt has also been decidedly beneficial. Among other conclusions reached are the following:

(1) Rape is especially valuable as a pasture for fattening sheep and lambs, owing to the season of the year at which it grows and to its high feeding value.

(2) It is an excellent food when preparing lambs for winter fattening.

(3) One acre of rape grown in drills immediately after a crop of rye cut as a green food will pasture from 10 to 16 lambs for from two to two and one half months, and that when grown as the sole crop of the season under favorable conditions it will sustain a much larger number.

(4) Ordinary grade lambs when pastured on rape, without any other food supplement, will make an average gain of 10 pounds per month.

(5) Rape is admirably adapted for growing as a catch crop to be fed off or plowed under as a green manure.

(6) Rape as a cleaning crop is probably without a rival in our present system of agriculture.

(7) Much care and prudence must be exercised in pasturing animals on rape or serious losses may follow.

(8) Rape is not an exhaustive crop on the soil when pastured off, as what has been taken from the cultivable area is returned to it and something in addition.

A. C. T.

Consumption and production of material by the sugar beet in the second year of growth, STROHMER, BRIEN, and STIFT (*Oesterr. Zeitsch. Zuckerind., 1892, p. 244; abs. in Chem. Ztg., 1892, Repert., p. 198*).—The following are the conclusions of the authors from a long series of experiments: The production of new material by the sugar beet in the second year is so extensive that the reserve materials stored in the root are insufficient, and consequently the beet should be set out in a rich or well-manured soil. In this growth the phosphoric acid is used principally in the formation of leaves and stems, and the nitrogen in seed production. The consumption of potash is quite uniform throughout

the period of growth, although at the time of seed formation a slight increase was noticed in the case of some varieties.—E. W. A.

Fractional application of nitrate of soda for winter wheat, V. LIEBENBERG (*Mitt. Ver. zur Ford. landw. Versuchswesens in Oesterreich, 1891, Heft 6; abs. in Centralbl. agr. Chem., 21, pp. 226–228*).—In continuation of similar experiments the previous year, experiments were made on three different farms to study the effect of applying given amounts of nitrate of soda all at one time in the fall, and half in the fall and half the following spring, either in April or May. The results confirmed those of the previous year. Fractional application of the nitrate increased the yield over the single application, and the result was noticeably in favor of making the spring application in April, rather than in May. The inference is that for winter wheat a fractional application of nitrate of soda is preferable, and that the spring dressing should be made as early as practicable.—E. W. A.

Experiments with cereals at the School of Practical Agriculture and Irrigation at Avignon, France, M. ALLIER (*Bul. de Min. de l'Agr., No. 1, Jan., 1892, pp. 15–21*).—These were with wheat and oats, and were a continuation of experiments begun in 1890.

The soil on which the experiments were conducted was an alluvium of the River Duance, with an extremely permeable subsoil which received a constant infiltration of the river water. The arable surface soil, extending to a depth of from 15 to 45 inches, was underlaid by a layer of sand mixed with gravel to a depth of more than 50 feet. Both chemical and mechanical analyses of the soil to a depth of 7.9 inches are given. It appears from these that the soil, which was decidedly calcareous, was rich in magnesia and poor in phosphoric acid. Its potash content was adequate for the culture of cereals.

Wheat.—In 1890 1 variety of wheat, *Richelle Blanche de Naples*, was cultivated, giving a yield of 39.5 bushels of grain per acre. In 1891 this variety was again cultivated, but in three different ways. One part of the field which had been seeded in the latter part of November, 1890, was not irrigated; the second part, seeded in the fall, in plats with raised borders arranged for irrigation by submersion, was irrigated three times during April and May; the third part, seeded in March, 1891, was also irrigated three times.

Comparative tests were also made with 2 other varieties, *Saissette de Provence* and Rimpau wheat, both seeded in November, 1890. The first was irrigated in the spring, the second received no irrigation. At time of seeding superphosphate (14 per cent soluble phosphoric acid), phosphatic slag, and sulphate of potash were harrowed in on all the plats in amounts furnishing 78.3 pounds of phosphoric acid (two thirds soluble) and 39.2 pounds of potash per acre. In the spring nitrate of soda was applied in the form of a top-dressing to the young wheat, in an amount furnishing 27.6 pounds of nitric nitrogen per acre. The Richelle, planted in autumn, not irrigated, ripened June 29 to July 5;

the Rimpau wheat, July 7; Richelle, planted in autumn, irrigated, July 8 and 9; Saissette, planted in autumn, irrigated, July 9; Richelle, planted in spring, July 16. The cost per acre for seeds, fertilizers, labor, general expenses, and rent of land was \$51.49. To this should be added \$2.15 as the cost of irrigation in the cases in which the latter was resorted to. The results of the experiment are given in the following table:

Varieties.	Yield per acre.			Financial results per acre.					Cost of grain per bushel.
	Grain.		Straw.	Value of—			Cost of production.	Net return.	
	Bushels.	Pounds.	Pounds.	Grain.	Straw.	Total yield.			
Richelle, seeded in the spring, irrigated	27.07	1,609.3	6,527.6	\$36.95	\$16.87	\$53.82	\$53.65	\$0.17	\$1.36
Richelle, seeded in autumn, not irrigated	35.00	2,173.5	5,687 6	49.62	14.93	64.55	51.49	13.06	1.04
Richelle, seeded in autumn, irrigated	47.34	2,941.1	6,520.4	67.15	16.85	84.00	53.65	30.35	0.78
Rimpau, seeded in autumn, not irrigated	47.27	2,842.9	7,153.3	64.68	18.49	83.39	51.49	31.90	0.70
Saissette, seeded in autumn, irrigated	46.76	2,903 6	9,818.6	66.29	25.38	91.67	53.65	38.02	0.61

Although the wheat suffered somewhat from the unfavorable season the results seem to justify the conclusion that under the conditions of these experiments the culture of wheat in the region of Avignon will prove profitable, especially if irrigation be practiced.

Oats.—In 1890 California Prolific oats were grown, giving a yield ot 57.8 bushels of grain per acre, with a net return of \$17.07. In 1891 this variety was grown with three others—Black Brie oats, Red-Capped oats, and Yellow Saline oats. All of the plats received the same fertilizer, in an amount furnishing total nitrogen 23.1 pounds, soluble phosphoric acid 100.6 pounds, and potash 28.5 pounds per acre. The cost of production was \$38.81 per acre. The returns per acre for the different varieties are given in the following table:

Varieties.	Yield per acre.			Financial results per acre						Cost per bushel of grain.
	Grain.		Straw.	Value of—			Cost of production.	Returns.		
	Bushels.	Pounds.	Pounds.	Grain.	Straw.	Total yield.		Profit.	Loss.	
California Prolific	63.38	2,311.8	5,784.0	\$34.85	\$14.95	\$49.80	\$38.81	\$9.99	......	\$0.38
Black Brie	47.30	1,762.0	5,409.1	26.56	13.98	40.54	38 81	1.73	......	0.53
Red-Capped	44.77	1,529.0	3,213.4	23.05	8.31	31.36	38.81	......	\$7.45	0.68
Yellow Saline	29.44	1,005.1	2,294.0	15.15	5.93	31.08	38.81	......	17.73	1.12

The California Prolific is the only variety which gave a satisfactory return. As a whole the results are very unfavorable as compared with those with wheat.—W. H. B.

Detection of castor-oil seed and of croton seed in feeding stuffs, J. W. Leather (*Analyst, 1892, pp. 121–127*).—The poisonous character of the seed of the castor-oil plant (*Ricinus communis*) and of croton

(*Croton tiglium*) is referred to and the statement made that "a small admixture of considerably less than 1 per cent of either of these seeds when present in a cattle food is sufficient to cause harm and even death." The method generally employed by the author for the recognition of the testa of seeds in food is to digest a portion of the material with 1 to 2 per cent hydrochloric or sulphuric acid for half an hour, decant the acid liquid, and wash the material several times by decantation; and then to digest the residue with equally dilute sodium or potassium hydrochlorate and wash by decantation. Treated in this way, the testæ of the seeds commonly found in feeding stuffs, as well as the impurities, are rendered sufficiently transparent to be recognized under the microscope. In the case of the seeds of the castor-oil and croton plants the method is not reliable, since "it requires probably three or four seeds or less per pound to cause serious illness or death to stock."

Trials of a solution of sodium hyposulphite and of dilute acid and alkali followed by sodium hypochlorite, for bleaching the seeds gave negative results, the seeds remaining entirely unbleached. Free chlorine gradually bleaches both castor and croton seed, the time required being from three to four days. The resistance of these seeds to the action of acid, alkali, and bleaching powder furnish a means for their recognition, for while the seeds of other plants were bleached by this treatment the castor and croton seed remained black.

Trials of the method on mixtures of castor and croton seed with undecorticated cotton cake indicated it to be not only qualitative, but also quantitative. In four out of five experiments made, the greater part of the seed testæ which were put into the cotton-seed cake was recovered. In the fifth case the croton seed was moldy, and is believed to have been partly bleached by the action of sodium hypochlorite. Tests of moldy castor beans bore out this supposition.

The following is the method proposed: One pound of the feeding stuff to be tested is boiled for an hour each with dilute hydrochloric acid and with dilute alkali to remove the starchy albuminoids and fatty substances, washing thoroughly after each digestion. From one half to 1 pound of bleaching powder is then added and sufficient water to prevent the temperature from rising (3 or 4 liters). The mixture is stirred occasionally and left to stand over night. In the morning the water is poured off and the residue washed several times by decantation, after which the residue is picked over by hand, separating the bleached from the unbleached pieces. This is done most readily by spreading small quantities on the bottom of a flat porcelain dish about half full of water. After the unbleached pieces have been separated they are readily examined, and anything other than castor or croton seed removed.

I may mention here that in a pound of bleaching powder a number of bits of coal or stone may be found, and further, in the case of cotton seed, the hilum does not always bleach so readily as the other portions, so that these would likewise be

separated with any castor or croton seed. * * * There is no difficulty in distinguishing the hilum, for the pieces are round and have no sharp edges; moreover they are marked by a series of rings alternating gray and black on the surface.

The testæ of the castor and croton seed are described as extremely brittle. Those of the castor seed are from 0.25 to 0.3 mm. in thickness, and of the croton seed from 0.2 to 0.25 mm. The former are said to have a much smoother and more shiny exterior than the croton seed after passing through the bleaching process. Viewed transversely, the structure of the two is very similar, each being made up of closely packed bundles of fibers of the same thickness. On the outermost edge of sections of croton seed testæ a distinct thickening of each of the bundles of fibers was noticed, while this was not observed in the sections of castor seed testæ. With a low power objective with reflected light a peculiar curvature of the bundles of fibers on the inner edge is readily seen. This is common to both of the seeds.—W. H. B.

Relation of the cream content to the fat content of milk, W. Thörner (*Chem. Ztg., 1892, pp. 757, 758*).—Some thirty tests were made in which the volume per cent of cream was determined by the creamometer and by whirling in a centrifugal machine. In the latter case the milk was (1) whirled at 59° F., (2) heated to 176° F. before whirling, and (3) mixed with an equal volume of water. The milk was placed in tubes and the centrifuge run for ten minutes at a velocity of 3,000 revolutions per minute. The percentage of fat was determined in each sample of milk. The most uniform results were obtained by diluting the milk with an equal volume of water. Making allowance for the water added the volume per cent of cream by this method was practically twice the per cent of butter fat. The variations from this were all within 0.2 per cent except in three cases, where they amounted to from 0.4 to 0.5 per cent. The author is unable to suggest any reason for these larger variations. He hoped to secure a simple and rapid means of determining the approximate amount of fat in milk.—E. W. A.

The acids of butter, E. Koefoed (*Bul. de Acad. 'l Royale Danoise, 1891; abs. in Analyst 1892, pp. 130–133*).—The butter examined contained 91.5 per cent of fatty acids of the following percentage composition:

Oleic acid; Acid of the formula $C_{15}H_{28}O_4$; Acid of the formula $C_{20}H_{54}O_5$ (?)	34.0
Stearic acid	2.0
Palmitic acid	28.0
Myristic acid	22.0
Lauric acid	8.0
Capric acid	2.0
Caprylic acid	0.5
Caproic acid	2.0
Butyric acid	1.5
	100.0

E. W. A.

Impurities in the Würzburg market milk and the source of the bacteria in milk, L. SCHULZ (*Arch. Hygiene, 14 (1892), pp. 260–271*).—The author determined the amount of sediment in a number of samples of milk and studied the origin of the bacteria in milk. In these latter studies the first and last portions of a milking of a cow and a goat were compared as to their bacteria content. The teats and udder of the animal and the hands of the milker were thoroughly washed with water and with corrosive sublimate solution previous to milking. About 200 c. c. of the milk drawn first and of the strippings were each caught in sterilized flasks; the latter were closed with plugs of cotton, immediately placed on ice, and taken to the laboratory for testing by means of plate cultures.

The following results show the average number of germs per 1 c. c. of milk:

Cow's milk	First portion	55,566
	Last portion	sterile.
Goat's milk	First portion	50,836
	Last portion	sterile.

In a second series of tests no sublimate solution was used for washing, but water was used freely. The average number of germs per 1 c. c. of milk were:

Cow's milk	First portion	97,240
	Last portion	500
	Middle portion	2,590
Goat's milk	First portion	78,718
	Last portion	665

The author believes the following conclusions to be warranted:

The enormous germ content of milk is not, as was previously supposed, due entirely to lack of cleanliness, but is partially accounted for by germs working up into the opening in the end of the teat, where under the favorable temperature they increase rapidly between the milkings, growing upon the traces of milk adhering to the outlet. They are largely washed out in the first portion of milk drawn, which accounts for the higher germ content of this portion. As the milking progresses the number of organisms in the milk naturally decreases, until the strippings may be sterile, as was found in the first tests made, though this is not believed to be the rule.—E. W. A.

Method of examining milk for tuberculosis bacilli, W. THÖRNER (*Chem. Ztg., 1892, pp. 791, 792*).—The method recently proposed by Ilkewitsch* is first described. This in substance is as follows: The casein in 20 c. c. of milk is coagulated with citric acid, and after filtering off the liquid portion is dissolved in water containing sodium phosphate. Any butter fat present is separated by shaking with 6 c. c. of an aqueous ether solution, and acetic acid is added to the fat-free liquid until the first signs of coagulation appear, when the mixture is placed in a copper test tube and whirled for a quarter of an hour in a centrifugal machine at the rate of 3,600 revolutions per minute. The test tube is tapered at the bottom and drawn out to a narrow tube, which

* Münchener med. Wochenschr., 1892.

can be closed. The sediment of the milk and the bacilli collect here in the whirling, and the lower portion of the tube is closed and the liquid poured off. The sediment is then placed on microscopic slides and examined under the microscope for tuberculosis bacilli. Ilkewitsch claims that the method admits of detecting bacilli in cases where inoculation of animals is without effect.

Without questioning the merits of the above method, the author submits his own in the belief that it is simpler and equally reliable. In this case 20 c. c. of milk in a glass test tube of about 50 c. c. capacity are mixed with 1 c. c. of 50 per cent potash solution (less advantageously with 2 c. c. concentrated ammonium hydrate), and heated for a couple of minutes in a boiling water bath until the solution turns yellowish-brown. The fat is thus saponified and the casein and albumin rendered soluble in acids. Twenty c. c. acetic acid is added, the solution shaken, heated again in a water bath for about three minutes, transferred to a strong glass tube, and treated centrifugally for ten minutes. The liquid is then poured off, and the sediment washed by shaking with 30 c. c. of hot water and again whirling. This washing is said to be essential. In the second whirling the same tube may be used as in the first, or one drawn out at the bottom to a narrow tube. The liquid is poured off, and the sediment placed on microscopic slides, colored first with fuchsin and then with methylene blue containing sulphuric acid, and examined under the microscope.

A number of trials of the method on milk which had been inoculated with tuberculosis bacilli showed it to be easily manipulated, rapid, and reliable, the bacilli being readily detected in each case.—E. W. A.

On margarin, WOLLENSTEIN (*Chem. Ztg., 1892, pp. 883, 884*).—The author reports observations on sixteen samples of margarin from American and European sources. The results of these follow:

Analyses of margarin.

Sample.	Melting point.	Melting point of fatty acids.	Hardening point of fatty acids.	Acid number.		Iodine equivalent.	Saponification equivalent of fatty acids.
				Before drying.	After drying.		
AMERICAN.	*Degrees C.*	*Degrees C.*	*Degrees C.*				
A	26.00	45.00	42.50	1.26	1.55	44.3	205.7
B	17.30	43.70	41.00	0.85	1.22	47.0	201.8
C	25.00	44.00	42.40	0.56	1.00	43.8	204.8
D	27.00	44.20	41.50	0.99	1.29	44.3	205.3
E	25.00	43.80	42.00	0.70	1.04	45.0	205.8
F	25.50	44.50	42.00	0.85	1.20	44.6	206.4
AUSTRIAN.							
G	25.00	42.90	41.50	1.35	1.60	45.8	206.0
H	26.00	43.00	41.00	0.85	1.01	47.2	205.7
I*	23.25	42.00	40.00	1.56	1.83	47.6	206.4
J	26.50	44.00	41.70	0.85	1.24	45.5	205.4
K	25.25	43.50	42.00	1.42	1.74	44.1	204.9
M	24.00	43.80	41.25	1.28	1.69	46.5	205.5
N	25.50	43.50	41.75	1.28	1.62	45.1	205.8
O	25.50	44.25	42.00	1.35	1.58	44.0	205.5
P*	24.75	43.70	42.20	1.30	1.59	44.4	206.8
Q	23.00	43.70	42.20	1.40	1.66	44.2	205.5

* Second quality.

The determinations of melting point were made as follows: The bulb of the thermometer of the Pohl apparatus was dipped into melted margarin, cooled to 13° C., and then heated until the fat commenced to run off. The true melting point is obtained by cooling to 0° C., allowing to remain for a day, and then heating until the fat begins to melt. By this method the melting point is always above 30° C., but for purposes of comparison the first method is said to give equally good results and to require less time. Any tendency toward crystallization, an important factor in the examination of margarins, is more sharply brought out by the first than by the second method.

The point of crystallization found by the author is somewhat higher than that observed by others and the iodine number somewhat lower (44 to 47 as compared with 50 to 55). He suggests that this may be due to other observers having used artificial butter instead of pure margarin.

The acid equivalent was determined before and after drying to 70° C. The results agree with those of previous observations in indicating that the acid equivalent and the degree of rancidity bear no causal relation to each other, for samples were found which before drying showed 1.4 and were of good taste, and others which showed 1 after drying and were rancid. He believes that the water is a potent factor in bringing about change, acting both as oxidizer and ozonizer. The natural coloring matter of margarin oxidizes and imparts an unpleasant taste to the fat; the neutral fat combines chemically with water and partially decomposes to glycerin and fatty acid. These are only some of the actions by which natural fats are decomposed. Thoroughly dried margarin oxidizes, although not as easily. The natural coloring matter of margarin is a very easily oxidizable body. To bleach it requires about one fortieth per cent permanganate solution. In the process of thoroughly bleaching, margarin dried at 70° C. increases slightly in weight by absorption of oxygen.

These matters bear upon the Welmans reaction with phosphomolybdic acid. Rancid margarin from which the natural color is partially or wholly bleached out fails to give the reaction, indicating that the oxidizable coloring matter is the cause of the reaction. The reagent is recommended for recognizing oxidizable bodies in fats and for recognizing cotton-seed oil in lard, but the author contends that it is not a general reagent for the detection of vegetable oils in animal fats.

The approximate composition of the fat in different samples of margarin is calculated as follows:

Approximate composition of margarin fat.

	Triolein.	Tripalmitin.	Tristearin.	Relation of palmitin to stearin.
AMERICAN.	*Per cent.*	*Per cent.*	*Per cent.*	
A	51.4	34.6	14.0	100. 40.5
B	54.5	15.6	39.9	100:255.7
C	50.8	30.2	19.0	100: 62.9
D	51.3	32.7	16.0	100. 48.9
E	52.2	35.1	12.7	100· 36.2
F	51.7	38.0	10.3	100: 27.1
AUSTRIAN.				
G	53.1	36.1	10.8	100: 29.9
H	54.8	34.6	10.6	100: 30.6
I[a]	55.2	38.0	6.8	100: 17.9
J	52.8	33.2	14.0	100: 42 2
K	51.1	30.7	18.2	100: 59.3
M	53.9	33.7	12.4	100: 36.8
N	52.1	35.1	12.8	100: 36.5
O	51.1	33.7	15.2	100: 45.1
P[a]	51.5	40.0	8.5	100· 21.2
Q	51.2	33.7	15.1	100. 44.8

[a] Second quality.

Sample B is regarded as an abnormal margarin.—E. W. A.

Contribution to the study of the growth of the vine, L. ROOS and E. THOMAS (*Ann. Agron., 18, No. 5, May, 1892, pp. 238–260*).—The authors determined, at regular intervals of two weeks, from May 15 to September 20, the proportion of dry matter, nitrogen, potash, phosphoric acid, sugar, and acid in the year's growth (berries, leaves, and vine) of a vine of the Aramon variety. The vineyard from which the vine for examination was chosen was located on a clay lime soil. It had been planted in 1884 and grafted with Aramon in 1886. The vine selected had been manured with farm manure in 1890. For each analysis a sufficient quantity of material was taken from the new growth in different parts of the vine, and the berries, leaves, and stems were separated from each other. The methods of sampling and analysis are given in detail. The sugar was determined before and after inversion. The presence of crystallizable sugar was also determined. The results are given as follows:

Composition (fresh material) of the vine at different stages of growth.

Date.	Stage of growth.	Dry matter.			Nitrogen.			Ash.			Potash.		
		Fruit.	Leaves.	Stems.	Fruit.	Leaves.	Stems.	Fruit.	Leaves.	Stems.	Fruit.	Leaves	Stems.
1891.		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
May 17	Bunches formed, but very small	14.27	21.85	13.20	0.49	0.74	0.21	1.29	1.58	1.12	0.47	0.33	0.37
May 31	Berries more distinct	15.15	23.03	17.45	0.52	0.94	0.31	1.32	1.82	1.18	0.43	0.44	0.38
June 14	2 or 3 days before flowering.	16.50	22.25	27.68	0.49	0.74	0.36	1.17	1.62	1.00	0.30	0.38	0.35
June 28	Flowering past	14.31	26.10	23.27	0.31	0.67	0.23	.94	2.40	1.28	0.35	0.52	0.45
July 12	Berries the size of an ordinary pea	8.82	30.30	27.10	0.26	0.78	0.27	0.38	2.51	1.34	0.15	0.38	0.42
July 26	Berries very rich in juice (60 per cent)	9.87	29.78	30.92	0.21	0.65	0.24	0.46	2.67	1.47	0.16	0.42	0.44
Aug. 9	Berries translucid, seeds visible	9.47	31.25	28.65	0.16	0.52	0.23	0.37	3.45	1.55	0.16	0.33	0.42
Aug. 23	Bunches beginning to ripen, berries purple	10.52	33.30	30.60	0.11	0.60	0.20	0.40	3.66	1.53	0.16	0.31	0.25
Sept. 6	As above, but color deeper.	15.15	36.80	43.86	0.11	0.56	0.22	0.47	3.68	1.73	0.22	0.29	0.39
Sept. 20	Little change in appearance	16.20	37.00	43.80	0.09	0.50	0.20	0.38	4.58	1.82	0.16	0.27	0.18

Composition (fresh material) of the vine at different stages of growth.

Date.	Stage of growth.	Phosphoric acid.			Sugar or glucose.						Acidity as sulphuric acid.		
					Fruit		Leaves.		Stems.				
		Fruit.	Leaves.	Stems.	Before.	After.*	Before.	After.	Before.	After.	Fruit.	Leaves.	Stems.
1891.		P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
May 17	Bunches formed, but very small	0.11	0.22	0.06	trace	trace	trace	0.50	trace	trace	..	...	....
May 31	Berries more distinct	0.17	0.21	0.08	trace	0.66	0.65	1.03	0.60	1.00	..		..
June 14	2 or 3 days before flowering	0.12	0.15	trace	0.66	0.74	1.10	1.15	1.10	1.35	1.12	1.12	0.49
June 28	Flowering past	0.09	0.11	0.06	0.48	0.65	1.35	1.65	1.25	1.35	1.19	1.01	0.35
July 12	Berries the size of an ordinary pea	0.04	0.11	0.06	0.42	0.71	1.25	1.35	1.30	1.35	1.81	0.63	0.17
July 26	Berries very rich in juice (60 per cent)	0.04	0.12	0.08	0.68	0.72	1.56	1.68	1.16	1.50	2.00	0.76	0.20
Aug. 9	Berries translucent, seeds visible	0.03	0.13	0.09	( )	1.01	..	1.27	. .	1.10	1.99	0.39	0.16
Aug. 23	Bunches beginning to ripen, berries purple	0.03	0.12	0.06	...	4.77	...	1.63	....	1.14	1.57	0.49	0.15
Sept. 6	As above, but color deeper.	0.04	0.12	0.07	.....	7.27	.	2.01	..	1.60	0.70	0.40	0.10
Sept. 20	Little change in appearance.	0.03	0.04	0.07	....	9.15	...	1.80		0.40	0.56	0.58	0.12

* After August 9 the results before and after inversion were practically the same.

The tabulated data show that the phosphoric acid decreased from the time of flowering to maturity in the leaves and berries. It remained very constant in the stems except at the period just before blooming (June 14), when only traces were found. It is suggested that this may be the result of an error in analysis. The dry matter increased steadily in the leaves and stems. In the fruit it remained stationary at between 14 and 16 per cent until the berries began to form, when it decreased to 8.82 per cent. It remained between 8 and 10 per cent for several weeks and then increased to 16.2 per cent by accumulation of sugar in the berries. The acid in all three organs was less at maturity than at the beginning of growth. For the leaves and twigs the decrease was quite regular, but this was not true for the vines. In these the amount of acid increased steadily until it was larger than in the other organs and then decreased as maturity advanced, until it was less than that in the leaves. At the stage when the berries began to mature there was a striking coincidence between the increase of sugar and the decrease of acid in the fruit. During the first ten or twelve weeks the per cent of sugar was less in the berries than in the other organs. As maturity approached the sugar in the fruit increased rapidly, but in the leaves and stem varied only within narrow limits throughout the season. At the beginning of growth the Fehling solution gave a very distinct reaction with the leaves and stems, while with the fruit it gave a scarcely visible precipitation. The authors found a crystallizable sugar in all three organs. This, as regards the fruit, is contrary to the observations of Petit.*

The origin of the sugars is discussed at length. Three theories have been advanced, (1) generation from tannin, (2) transformation of starch, and (3) transformation of acids. The first of these theories has been

* Compt. rend., 69 and 77.

generally abandoned. As regards the second, it is stated that since starch has been found by Sachs, Cuboni, and Schimper to be a constituent of the leaves and all green parts of the vine, it may reasonably be assumed that it is one of the sources of sugar. This view is combated by Buignet, who denies the presence of starch in the acid fruit, and states that it can in no case furnish the sugar of the grape since that is levorotary and starch by inversion furnishes dextrose, which rotates to the right 53°. It appears probable that a part of the glucose may be furnished by the inversion of the sucrose. A part may be furnished by the saccharification of starch by means of the amylase found by Brassé* in the leaves of a large number of plants, the dextrose being furnished by the ordinary starch, and levulose by a kind of inulin, or it may come from a different source, as suggested further on.

An inspection of the tables and diagrams showing the relation between the absolute acid and sugar content of the vine at different dates from June 28 to September 20, shows that between August 9 and 23 the absolute amount (in grams) of sugar in an average branch increased from 3.47 to 29.17 (twenty-five times that for any previous period of equal length), while the acid increased from 6.84 to 9.6 in the same period. Subsequently the acids began to diminish. It can not be admitted, therefore, that the acids furnish all the sugar, but it is possible that they may furnish a part.

It appears from observations by the authors and by Bouffard and Dehérain that dextrose is first formed in the grape, and about the time of maturity there is a rapid increase of levulose. The decrease of acid is therefore accompanied by an increase of levulose, and one is led to the conclusion that if the acids contribute to the formation of sugar it is levulose which is produced.

The increase in dry matter and fertilizing constituents is shown in tables and diagrams. These show a constant increase from the beginning of vegetation to the time of harvesting. The sums (in grams) of the potash, nitrogen, and phosphoric acid contained by an average branch were as follows:

June 28	1.451
July 12	1.959
July 26	2.363
August 10	2.419
September 6	3.158
September 21	2.977

As this increase is common to all the organs, the authors conclude that it can not be laid down as a rule, as Michaut and Vermorel† have stated that the development of the fruit is entirely dependent upon the

* Dissol. de l'amidon dans les feuilles (Ann. Agron., 12).
† Les engrais de la vigne.

leaves and vines. At the time of harvest, calculating on the basis of 100 parts of nitrogen, there are the following proportions of fertilizing materials in the three organs:

	Grapes	Leaves.	Vines.	Total.
Nitrogen	58	33	10	100
Potassium oxide	80	13	7	100
Phosphoric acid	70	10	3	90

In view of the facts presented, the authors are inclined to agree with Zacharewicz* in considering nitrogen of considerable importance in a fertilizer for grapes, although the matter needs further confirmation.

The authors sum up the conclusions applicable to this variety of grape and to the conditions of this experiment as follows:

(1) A saccharose is present in the leaves, stems, and grapes during the first three months of growth.

(2) The absolute decrease of acid is not correlative with the increase of sugar in the plant or fruit.

(3) A decrease of acid is observed at the same time that a notable increase of levulose takes place in the fruit.

(4) The dry matter increases steadily from the beginning of growth to time of harvesting.

(5) The assimilation of fertilizing materials is continuous up to maturity.

(6) It can not be admitted, as various authors have maintained, that the fruit is formed at the expense of the substances accumulated in the leaves and stems at the time of flowering or a few days after. These organs do not act as intermediate agents in the formation of the fruit.

(7) The authors are inclined to attribute an important rôle in grape production to the nitrogenous manures.—W. H. B.

* Les engrais appliqués à la culture de la vigne (Ann. Agron., 17, p. 122).

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Apparatus for washing precipitates, M. FORBES.—*Chem. News, 66 (1892), p. 55.*

Conversion table for use in phosphoric-acid determinations where a half gram of substance is taken (*Tabelle zur Berechnung der Phosphorsäure bei Anwendung von 0.5 Gram Substanz*), F. SCHEIDING.—*Chem. Ztg., 1892, No. 64, pp. 1145–1147.*

The physiological function of calcium and magnesium salts in plants (*Die physiologischen Funktionen der Calcium und Magnesiumsalze im Pflanzenorganismus*), O. LOEW.—*Flora, 1892, pp. 368–394.*

Intermolecular respiration in plants (*Die intermolekulare Atmung der Pflanzen*), W. DETMER.—*Ber. deut. bot. Ges., 10, pp. 201–205.*

On the rooting of cultivated plants in its physiological and cultural aspects, I (*Untersuchungen über die Bewurzelung der Kulturpflanzen in physiologischer und kultureller Beziehung; erste Mittheilung*), C. KRAUS.—*Forsch. Geb. agr. Physik, 15, Heft 3 and 4, pp. 234–286.*

Recent investigations on the chemistry of fermentation (*Neuere Forschungen auf dem Gebiete der Gährungschemie*), E. BOSSHARD.—*Naturwiss. Rundschau, 7 (1892), No. 34, pp. 429–433.*

On the coloring matter of Micrococcus prodigiosus (*Sur la matière colorante du Micrococcus prodigiosus*), A. B. GRIFFITHS.—*Compt. rend., 115 (1892), No. 6, pp. 321, 322.*

The carbonic-acid content of the atmosphere (*Untersuchungen über der Kohlensäuregehalt der Atmosphäre*), H. PUCHNER.—*Forsch. Geb. agr. Physik, 15, Heft 3 and 4, pp. 296–383.*

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The origin of soils (*Die Entstehungsweise des Bodens*), G. RÖRIG.—*Fühling's landw. Ztg., 1892, Heft 16, pp. 580–585, and Heft 17, pp. 630–638.*

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The effect of liming on the porosity of clay soils, A. N. PEARSON.—*Chem. News, 66 (1892), pp. 53, 54.*

On the growing of crops in the fall for green manuring (*Sur les cultures dérobées d'automne, utilisées comme engrais verts*), P. P. DEHÉRAIN.—*Compt. rend., 115 (1892), No. 5, pp. 273–277.*

The use of fresh night soil (*Noch einmal Verwendung frischen Abortdüngers*), A. RITTER.—*Mitt. deut. landw. Ges., 1892, No. 7, pp. 82–84.*

Value of sweepings of streets and houses as fertilizers (*Wie hoch beläuft sich der Düngewerth von Strassenkehricht und Hauskehricht?*) J. H. VOGEL.—*Mitt. deut. landw. Ges., 1892, No. 8, pp. 89, 90.*

Contribution to the care of barnyard manure (*Ein Beitrag zur Pflege des Stallmistes*), J. H. VOGEL.—*Mitt. deut. landw. Ges., 1892, No. 9, pp. 96, 97.*

The solubility of the phosphoric acid in ground bone (*Die Löslichkeit der Phosphorsäure des Knochenmehles*), H. OTTO.—*Chem. Ztg., 1892, No. 63, p. 1128.*

Contribution to the chemistry of Thomas slag (*Beitrag zur Chemie der Thomasschlacke*), M. A. VON REIS.—*Zeitsch. angew. Chem., 1892, pp. 229–231.*

Comparative action of ammonium sulphate and nitrate of soda (*Wie Wirkt das schwefelsaure Ammoniak im Vergleich zum Chilisalpeter?*)—*Der deut. Landwirt, 1892, No. 30.*

Some fertilizer experiments on sandy soils, C. VON FEILITZEN.—*Svenska Mosskulturföreningens tidskrift, 1892, pp. 158–160; abs. in Centralbl. agr. Chem., 21, Heft 8, pp. 505, 506.*

Fertilizer and culture experiments by the Swedish society for moor culture in 1892, C. VON FEILITZEN.—*Svenska Mosskulturföreningens tidskrift, 1891, pp. 470–475, and 1892, pp. 62–74, 158–163; abs. in Centralbl. agr. Chem., 21, Heft 8, pp. 506–510.*

Comparative effect of Redonda, Alto-Velo, and Los Roques phosphates (*Ueber die düngende Wirkung des Redonda, Alto-Velo, und Los Roques Phosphats*), ULBRICHT.—*Der Landbote, 1892, No. 10, p. 79.*

The color of barley for brewing (*Die Farbe der Braugerste*), A. ZOEBL.—*Fühling's landw. Ztg., 1892, Heft 16, pp. 598–602.*

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Experiments on the effect on the yield of potatoes of the quantity of seed used, and of allowing the seed tubers to wilt or to sprout (*Vergleichende Anbau-*

Versuche über Einfluss der Grösse und das Anwelkins von Saatkartoffeln), V. UHRMANN.—*Fuhling's landw. Ztg., 1892, Heft 16, pp. 606–608.*

Experiments with fertilizers for sugar beets (*Zuckerrüben-Düngungsversuche*).—*Braunsch. landw. Ztg., 1892, No. 35, p. 147.*

Progress in the chemistry of tobacco (*Fortschritte auf dem Gebiete der Tabakchemie*), R. KISSLING.—*Chem. Ztg., 1892, No. 64, pp. 1153–1155.*

Yield of bushed and unbushed peas (*Ertrag gesteckter und nicht-gesteckter Erbsen*), MAREK.—*Der Landwirt, 1892, No. 4, p. 19; abs. in Centralbl. agr. Chem., 21, Heft 8, pp. 544, 545.*

The present condition of fruit-growing in Germany (*Ueber die Gegenwärtige Lage des Obstbaues in Deutschland*), GOETHE-GEISENHEIM.—*Mitt. deut. landw. Ges., 1892, No. 8, pp. 86–89, and No. 9, pp. 94–96.*

The prevalence of rusts on grain in 1892 (*Auftreten des Getreiderostes im Jahre 1892*), P. SORAUER.—*Mitt. deut. landw. Ges., 1892, No. 9, pp. 93, 94.*

A case of poisoning from eating leaves of grapevines sprayed with copper insecticide (*Schädlichkeit der Verfütterung der mit Kupfervitriol-Kalkmischung bespritzten Rebenblätter*), J. LATSCHENBERGER.—*Wiener landw. Ztg., 1892, No. 61, pp. 494, 495.*

The digestibility of food (hay and oats) under different conditions in the case of different animals (*Ueber die Verdaulichkeit des Futters (Heu und Hafer) unter verschiedenen Umständen und bei verschiedenen Thieren*), H. WEISKE.—*Landw. Jahrb., 21 (1892), Heft 5, pp. 791–807.*

Effect of bodily exertion on the digestion of the food (*Der Einfluss körperlicher Anstrengung auf die Ausnutzung der Nahrung*), S. ROSENBERG.—*Pflüger's Arch., 52, pp. 401–411; abs. in Chem. Centralbl., 1892, II, No. 6, p. 250.*

Adulteration of foods, especially of milk, in England (*Verfälschung der Nahrungsmittel, besonders Milch, in England*), O. HEHNER.—*Abs. in Molk. Ztg., 1892, No. 34, p. 415.*

The Jersey, Guernsey, and Alderney breeds of cows, and their importance to breeding in Germany (*Das Kanalinsel-Vieh (Jerseys, Guernseys und Alderneys) und seine Bedeutung für die deutsche Rindviehzucht*), H. HUCHO.—*Landw. Jahrb., 21 (1892), Heft 5, pp. 703–790.*

Fluctuations in the live weight of cows during a period of lactation (*Ueber des Verhalten des Lebendgewichtes der Kühe im Laufe einer Laktationsperiode*), J. NEUMANN.—*Milch. Ztg., 1892, No. 33, pp. 561–563.*

Preservation of milk samples for analysis, J. A. ALEN.—*Kgl. landtbruksakademiens handlingar, 1892, pp. 54–61; abs. in Centralbl. agr. Chem., 21, Heft 8, pp. 549, 550.*

The Pasteurizing of milk and cream, and the employment of pure cultures of organisms for ripening as means of getting rid of numerous undesirable qualities of milk and butter, H. P. LUNDE.—*22 Beretning fra den Kgl. Vert. und Landbohöjskoles Laboratorium for landökonomiske Forsög., Kjöbenhavn, 1891, pp. 67–117; abs. in Centralbl. agr. Chem., 21, Heft 8, pp. 554–563.*

Preservatives and their importance in dairying (*Die Konservirungsmittel und ihre Bedeutung im Molkereibetrieb*), M. KRUEGER.—*Molk. Ztg., 1892, No. 34, pp. 413, 414.*

Supervision of the milk trade by the sanitary police (*Ueber die sanitätspolizeiliche Ueberwachung des Milchverkehrs*), H. SCHÄFER.—*Abs. in Molk. Ztg., 1892, No. 34, p. 415.*

Experiments in preserving butter in granular condition in brine (*Versuche betreffend das Aufbewahren der Butter in gekörntem Zustande in Salzwasser*), J. SIEDEL.—*Milch Ztg., 1892, No. 34, pp. 577, 578.*

Analyses of cheese made from mares' milk, G. SARTORI.—*La Stazione speriment. agric. ital., 22, pp. 337–339; abs. in Chem. Centralbl., 1892, II, No. 9, p. 369.*

Hygrometer for the cheese cellar (*Feuchtigkeitsmesser für die Käsekeller*).—*Molk. Ztg., 1892, No. 34, pp. 414, 415.*

Annual report of the Prussian agricultural experiment stations for 1891 (*Jahresbericht über das agrikultur-chemische Versuchswesen in Preussen für das Jahr 1891*), PRUSSIAN MINISTER OF AGRICULTURE, DOMAINS, AND FORESTS.—*Landw. Jahrb., 21 (1892), Sup. I, p. 83.*

Annual report of the experiment station at Dahme, Germany, 1891–'92 (*Jahresbericht über die Thätigkeit der agricultur-chemischen Versuchsstation Dahme*), ULBRICHT.—*Der Landbote, 1892, No. 60, pp. 535–538.*

Statistics of the Prussian agricultural schools for 1891 (*Statistik der landwirthschaftlichen und zweckverwandten Unterrichts-Anstalten Preussens nach dem Stande am Schlusse des Jahres 1891*), PRUSSIAN MINISTER OF AGRICULTURE, DOMAINS, AND FORESTS.—*Landw. Jahrb., 21 (1892), Sup. I, p. 215.*

Agricultural statistics for Prussia for the year 1891, part I (*Beiträge zur landwirthschaftlichen Statistik von Preussen für das Jahr 1891, erster Theil*), PRUSSIAN MINISTER OF AGRICULTURE, DOMAINS, AND FORESTS.—*Landw. Jahrb., 21 (1892), Sup. I.*

Effect of agricultural experimentation on agriculture (*Der Einfluss landwirthschaftlicher Versuchsthätigkeit auf die Agricultur*), J. HANAMANN.—*Wiener landw. Ztg., 1892, No. 64, pp. 517, 518, and No. 65, pp. 525–527.*

EXPERIMENT STATION NOTES.

ALABAMA COLLEGE STATION.—The following titles of publications, issued by this station, should be added to the list published in Experiment Station Record, vol. III, p. 937: Bulletin No. 3, March 14, 1884, Catalogue of Fruits; Bulletin No. 4, May, 1884, Experiments in Cotton; Bulletin No. 6, November 18, 1884, Rules and Regulations, and Suggestions to Farmers Relative to the purchase and Sale of Fertilizers; Bulletin No. 7, January, 1885, Experiments with Corn, Peas, etc.; Bulletin No. 8, March, 1885, The Bollworm and the Cotton worm; Bulletin No. 9, April 2, 1885, Commercial Fertilizers; Bulletin No. 10, August, 1885, Nitrogenous Manures; Bulletin No. 1, September, 1885, The Grape; Bulletin No. 2, 1885, Fertilization; Bulletin No. 6, February, 1886, Experiments in Cotton Culture; Bulletin No. 7, March, 1886, Improvement of Soils, etc.

G. F. Atkinson, Ph. B., has accepted a professorship in Cornell University. W. F. Flagin has been appointed clerk vice W. B. Frazer.

The experiments with tobacco in progress at the station have shown that plants of good size can be grown in that region.

ALABAMA CANEBRAKE STATION.—B. M. Duggar, M. S., has been elected assistant director in charge vice W. H. Newman.

CALIFORNIA STATION.—The following corrections should be made in the organization list of the station published in Experiment Station Bulletin No. 12: E. J. Wickson, M. A., is horticulturist as well as agriculturist; M. E. Jaffa, PH. B., is an assistant in chemistry instead of in agriculture. A. V. Stubenrauch has been appointed clerk to the director vice J. W. Blankenship.

COLORADO STATION.—F. O. Congdon has been appointed stenographer vice L. M. Taylor.

CONNECTICUT STATE STATION.—C. G. Voorhees, PH. B., who for the past year has been engaged with Dr. Osborne in the investigation of proteids, has resigned to accept a fellowship at Columbia College.

GEORGIA STATION.—The experiments in cheese-making have been very successful. The station will operate a cheese dairy at the State Fair at Macon. Tobacco-curing by the leaf-cure process has proved satisfactory. Experiments in cross-fertilization of different varieties of cotton are giving promising results.

OHIO STATION.—On September 1 the headquarters of the Ohio Station were transferred to Wooster, where a farm of 450 acres has been purchased for its use out of the proceeds of Wayne County's donation to secure the location of the station. The farm contains three commodious dwellings and as many large barns, and the station is now erecting a block of four greenhouses, each 20 by 100 feet, with an arcade across one end 14 by 82 feet, and a stone building one and one half stories high with deep basement window for boiler house, coal storage, and greenhouse offices. A one-story stone building, 18 by 34 feet in size, with two greenhouses attached, each 14 by 28 feet, is also being erected for the use of the entomologist and vegetable pathologist of the station. It is expected that these buildings will be ready for occupation by November 1. The erection of the principal office or administrative building and feeding barn will be deferred until next season.

A tract of more than 50 acres of very uniform land is being laid off in tenth-acre plats for variety work, and several smaller tracts are being platted for work with fertilizers, etc.

PENNSYLVANIA COLLEGE.—The short winter course in agriculture for 1893 will open Wednesday, January 4. This course consists of two hundred lectures upon agriculture, agricultural chemistry, botany, horticulture, and veterinary science, together with practical exercises in the field, barn, dairy, greenhouse, etc.

The course of home readings in agriculture for the coming season is as follows:

Group I. Crop production.—Plant life on the farm, Masters; Soils and crops, Morrow and Hunt; Gardening for profit, Henderson; Talks on manures, Harris; Practical drainage, Chamberlain.

Group II. Live stock production.—Horse breeding, Sanders; Horses, cattle, sheep, and swine, Curtis; Feeding animals, E. W. Stewart; Dairyman's manual, Henry Stewart; Veterinary science, James Law.

Group III. Horticulture and floriculture.—The propagation of plants, Fuller; The fruit garden, Barry; Practical floriculture, Henderson; Ornamental gardening, Long; Insects and insecticides, Weed.

SOUTH CAROLINA STATION.—R. N. Brackett has been added to the station staff as assistant chemist.

TEXAS STATION.—R. H. Price, formerly assistant horticulturist of the Virginia Station, has been appointed horticulturist of the Texas Station. He will also have charge of work in botany and entomology.

AMERICAN ASSOCIATION OF STATE WEATHER SERVICES.—A convention of representatives of State weather services was held in Rochester, New York, August 15 and 16, 1892, in conjunction with the forty-third meeting of the American Association for the Advancement of Science. The convention was called to order by Prof. M. W. Harrington, chief of the Weather Bureau, who made an address of welcome to the representatives present. He suggested certain important subjects for discussion, and appointed committees on permanent organization, etc.

A permanent organization was effected and the following officers were elected: President, Maj. H. H. C. Dunwoody; first vice president, B. S. Pague of Oregon; second vice president, G. H. Chappel of Iowa; secretary, R. E. Kerkam, chief of State Weather Service Division, Weather Bureau; and treasurer, W. L. Moore of Wisconsin.

The title American Association of State Weather Services was adopted by the convention, and it was decided to hold annual conventions in future at the same time and place as those of the American Association for the Advancement of Science.

Representatives were in attendance from the central office of the Weather Bureau, Washington, D. C., Arkansas, California, Illinois, Indiana, Iowa, Kentucky, Michigan, Nebraska, New England, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Dakota, Utah, Virginia, and Wisconsin.

Many of the representatives who were unable to be present at the convention forwarded papers giving their views on various subjects of interest.

The subject of instrument shelters and a uniform manner of their exposure was debated, and it was the consensus of opinion that a uniform pattern of shelter should be adopted for use throughout the entire country. The subject was referred to a committee consisting of Messrs. Smith, Moore, and Pague, with instructions to report as to the most suitable shelter and manner of exposure to be generally adopted by State weather services.

On the subject of whether the voluntary observers should be supplied with self-registering maximum and minimum thermometers, the prevailing opinion was that such instruments should be issued and used in determining temperature, means, and averages wherever and whenever practicable. The old method of making readings at 7 a. m., 2 p. m., and 9 p. m., observations of the dry thermometer, shall be continued wherever desired, but the means should be deducted from the self-registering thermometers where such instruments are in use.

The forecasting of thunderstorms was discussed and an interesting paper on this topic was read by the Wisconsin representative.

The proposition to print the weekly, monthly, and annual reports of the State weather services in a uniform manner was freely discussed. The desirability of uniform reports was generally admitted, but it was thought impracticable at this time to take any action in the matter, as a number of States have appropriated funds for printing reports according to definite size and style.

The discussion of the question of the best methods of signaling forecasts by displaymen covered a wide range. The flag, the whistle, the semaphore, and the sphere, and bomb and flash light systems were freely discussed, and an interesting paper was presented by the representative from New England on the system of spherical bodies hoisted on a staff. This subject was referred to a committee composed of Messrs. Conger, Glenn, and Kerkam, for report at the earliest practicable date.

On the subject of inspection of voluntary observers' stations the decision was that each voluntary observer's station should be inspected at least once a year, to keep up the interest of the voluntary observers and to enable the directors of State weather services to become thoroughly familiar with each station and its surroundings. It was recommended by the Association that sufficient leave of absence be granted the Weather Bureau representative at each State service center to enable him to make a tour of inspection.

Relative to the subject "the relation of State weather services to agricultural colleges and experiment stations," it was decided that owing to the lack of telegraphic facilities and other means of disseminating weather information, it would not be practicable generally to have the central stations of the State weather services at such colleges or stations, but that a very close coöperation would be desirable.

With reference to an exhibit at the World's Columbian Exposition, it was decided that each State service should have its exhibit in the building set apart for the use of the State and that the exhibits should not be collected in the building for the use of the United States Weather Bureau.

BRAZIL.—The governor of Para, Hon. Lauro Sodré, requests that publications of agricultural schools be sent to him.

ERADICATION OF PLEURO-PNEUMONIA.—The following proclamation was issued by the Secretary of Agriculture September 26, 1892:

"Notice is hereby given that the quarantines heretofore existing in the counties of Kings and Queens, State of New York, and the counties of Essex and Hudson, State of New Jersey, for the suppression of contagious pleuro-pneumonia among cattle, are this day removed.

"The removal of the aforesaid quarantines completes the dissolving of all quarantines established by this Department in the several sections of the United States for the suppression of the above-named disease.

"No case of this disease has occurred in the State of Illinois since December 29, 1887, a period of more than four years and eight months.

"No case has occurred in the State of Pennsylvania since September 29, 1888, a period of four years within a few days.

"No case has occurred in the State of Maryland since September 18, 1889, a period of three years.

"No case has occurred in the State of New York since April 30, 1891, a period of more than one year and four months.

"No case has occurred in the State of New Jersey since March 25, 1892, a period of six months, and no case has occurred in any other portion of the United States within the past five years.

"I do therefore hereby officially declare that the United States is free from the disease known as contagious pleuro-pneumonia."

J. M. RUSK,
Secretary.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

AUGUST, 1892.

DIVISION OF STATISTICS:

Special Report of the Statistician for July, 1892.—Foreign Crop Reports and Miscellaneous Information; Freight Rates of Transportation Companies.

Report No. 98 (new series), August, 1892.—Condition of Growing Crops.

DIVISION OF ENTOMOLOGY:

Insect Life, vol. IV, Nos. 11 and 12.

WEATHER BUREAU:

Bulletin No. 3.—A Report on the Relations of Soil to Climate.

Bulletin No. 4.—Some Physical Properties of Soils in their Relation to Moisture and Crop Distribution.

Instructions for Special River Observers.

Instructions to Operators on the United States Seacoast Telegraph Lines.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. III, No. 12.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

AUGUST, 1892.

ARKANSAS AGRICULTURAL EXPERIMENT STATION:

Fifth Annual Report, 1892.

AGRICULTURAL EXPERIMENT STATION OF FLORIDA:

Bulletin No. 17.—Analysis of the Orange; The Horn Fly; Questions Concerning Stock Diseases.

GEORGIA EXPERIMENT STATION:

Second Annual Report, 1889.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Bulletin No. 41, August, 1892.—Field Experiments with Wheat; Forms of Nitrogen for Wheat.

Special Bulletin, August, 1892.—Commercial Fertilizers.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 41, July, 1892.—Commercial Fertilizers.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Annual Report, 1891.

Bulletin No. 7, December, 1889.—Farm Manures.

Bulletin No. 16, March, 1892.—Wheat Insects.

Special Bulletin H, July, 1892.—Government Direction of Agriculture in Europe.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 43, July, 1892.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 86, July, 1892.—Fertilizer Analyses.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 21, June, 1892.—Insects Injurious to Cabbages; A New Method for Testing Milk; Feeding for Milk and Butter.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Tenth Annual Report, 1891.

Bulletin No. 43 (new series), June, 1892.—Experiments in the Manufacture of Cheese during May.

Bulletin No. 44 (new series), August, 1892.—Strawberries.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 39, July, 1892.—Creaming and Aërating Milk.

Bulletin No. 40, July, 1892.—Removing Tassels from Corn.

Bulletin No. 41, August, 1892.—The Comparative Merits of Steam and Hot Water for Greenhouse Heating.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 86c, June 30, 1892.—Meteorological Summary for North Carolina, May, 1892.

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 6, June, 1892.—The Mustard Family.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:
Fourth Annual Report, 1891, part II.
Bulletin No. 17, June, 1892.—Analyses of Commercial Fertilizers, State Inspection, 1892.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 5, July, 1892.—Methods of Keeping Sweet Potatoes.
Bulletin No. 6, July, 1892.—Analyses of Commercial Fertilizers.

TENNESSEE AGRICULTURAL EXPERIMENT STATION:
Bulletin vol. V, No. 2, April, 1892.—Grasses of Tennessee, part I.

AGRICULTURAL EXPERIMENT STATION OF UTAH:
Bulletin No. 13, May, 1892.—Feeding Hay and Grain Mixed to Horses; Feeding Cut Hay *vs.* Whole Hay to Horses.
Bulletin No. 14, June 1, 1892.—Horticulture and Entomology.
Bulletin No. 15, August, 1892.—Soiling Steers, or Green *vs.* Dry Food.
Bulletin No. 16, August 1, 1892.—The Digestibility of Green and Dry Timothy.

VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE EXPERIMENT STATION:
Bulletin No. 16, May, 1892.—Coöperative Corn Tests.
Bulletin No. 17, June 4, 1892.—Diseases of the Apple.

WASHINGTON AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 4, May, 1892.—Wireworms.
Bulletin No. 5, May, 1892.—Report of Farmers' Institute at Pomeroy, Washington.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:
Bulletin No. 32, July, 1892.—Feeding Grain to Lambs.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:
Report of Experimental Farms for 1891.

EXPERIMENT STATION RECORD.

VOL. IV. OCTOBER, 1892. NO. 3.

The preservation of barnyard manure is deservedly commanding considerable attention at the foreign stations. Investigations by Holdefleiss and others have shown the extent of the losses of nitrogen and humus liable to occur as a result of fermentation unless steps are taken to moderate the fermentation and to absorb and hold the gaseous products set free. They have shown that the nitrogen and humus in barnyard manure may be conserved to a very large degree by the addition to it of small quantities of superphosphate, superphosphate gypsum, potash salts, gypsum, earth, etc. As a result of these inquiries, rules for practice in caring for manure in the barn and in the field have been formulated. Indeed, Maercker recently announced in a farmers' institute that there was no longer any reason why *all* of the nitrogen should not be conserved, and intimated that the farmer who suffered any of this most expensive of fertilizing ingredients to be lost neglected an important point in his farm practice.

The care of barnyard manure, the means for conserving its essential ingredients, and the connection between the character of the manure and the nature of the feeding stuffs used have not received the attention which the importance of the subject warrants. Now that there is no longer any reasonable doubt that leguminous crops may derive their supply of nitrogen from the atmosphere, it seems highly desirable that the added value which the growing and feeding of such crops gives to the manure produced, and the advantage of such practice as an economical means of maintaining the supply of nitrogen in the soil, should be impressed upon the farmer both by example and precept.

By means of field experiments with manure derived from different crops and preserved in different ways, the practical phase of the subject might be graphically illustrated. Such experiments need not be long continued before results can be secured. In trials at one or two stations in Germany the effect of careful and careless treatment of manure on the yield of crops has been quite impressively shown in a single year.* The plan of the experiments may be comparatively simple, and no special equipment is required, except suitable provisions for preserving the manure.

* E. S. R., vol. III, p. 821.

The recently published *Traité de Chimie Agricole*, by P. P. Dehérain, is a notable contribution to agricultural literature. This work is not a text-book of agricultural chemistry, but is a general exposition, along certain lines, of the present state of agricultural research in Europe, more particularly in the field of chemistry. It gives a clear and comprehensive view of the work already accomplished, especially by the experiment stations and laboratories, in various lines of agricultural investigation. Its value, therefore, is not restricted to the agricultural chemist, but will be appreciated by students of agriculture in general. The volume contains nine hundred and four octavo pages, with fifty-four illustrations, and is divided into three parts: Growth of Plants, pp. 1–336; Arable Soil, pp. 337–514; and Soil Improvers and Fertilizers, pp. 515–883. The first part contains chapters on Germination, Assimilation of carbon, Assimilation of nitrogen, Mineral constituents of plants, Mineral nutrition of plants, Assimilation of mineral substances by plants, Respiration, Proximate constituents of plants, Movement of water in the plant, and Development and maturity. The second part is divided into six chapters: Formation of arable soils, Physical properties of arable soils, Chemical analysis of arable soils, Chemical constitution of arable soils, Absorbent properties of arable soils, and Sterility of arable soils. The third part is divided into two sections: The first section, Soil Improvers or Amendments, pp. 514–583, contains chapters on Calcareous manures, marl, lime, and calcareous sea sand (*tangues*); Application of plaster; Fallow and cultivation; and Irrigation. The second section, Fertilizers, pp. 583–880, is devoted to chapters on Vegetable fertilizers; Fertilizers of animal origin; Use of excrementaceous matter in agriculture; Nitrogenous fertilizers—sulphate of ammonia and nitrate of soda; Farm manure—night soil; Phosphates; Potassic fertilizers, chloride of sodium, and sulphate of iron; Chemical fertilizers; Fertilizer trade and inspection; and Cost and valuation of fertilizers. There is an appendix, giving the results of recent work by Schlösing, jr., and Laurent on the fixation of free nitrogen by plants of low orders.

The above condensed table of contents will serve to indicate in general the field covered. A closer examination of the work will show that discussions of recent advances in the study of nitrification, fixation of nitrogen by soils, and the assimilation of free nitrogen by plants (symbiosis) and chemistry of the soil are given prominent places, and that the space devoted to descriptions of individual experiments is relatively large. The references to articles (especially those appearing in French journals) from which material is drawn are quite complete, but the lack of an index detracts largely from the value of the book for purposes of reference.

INSTITUTIONS FOR AGRICULTURAL INVESTIGATION IN ITALY.

L. Paparelli.

The institutions for investigations in agricultural science in Italy may be classified as follows: (1) Agricultural experiment stations, general and special; (2) chemico-agricultural laboratories; (3) experimental cellars; (4) experimental oil mills; (5) sericultural observatories; (6) dairying observatories; (7) viticultural observatories; (8) experimental fields for the treatment of Phylloxera; (9) œnotechnical stations in foreign countries; (10) zoötechnical stations; (11) fish culture stations; (12) meteorological stations; (13) sanitary station and houses in the Alpine region.

Agricultural experiment stations.—Most of the experiment stations in Italy were established during the years 1870, 1871, and 1872. They are either autonomous or connected with other institutions. The studies undertaken by the stations are not limited by a special outlined program; they may be made at one station only or at several stations at the same time.

The studies and investigations of each station are made in accordance with its own judgment, or at the request of the Ministry of Agriculture, of local corporations which contribute to the maintenance of the station, or of public or private administrations. A small fixed charge is made for analyses made at the request of public or private parties, but the determination of fungi and injurious insects is made free of charge. Information relating to agricultural subjects is freely given. The stations are primarily experimental scientific institutions, but give practical instruction in their laboratories to young men desirous of pursuing specialties in agricultural science. The stations also give some public lectures in order to make known such results of their experiments or of those of others as may be of benefit to local agriculture. In some special stations there are short yearly courses of instruction in certain branches.

The funds of the station are given either by the State alone or by the State and local corporations, such as the provinces, towns, agricultural societies, and chambers of commerce. The administration of the funds is in charge of the director, who must report to the Ministry of Agriculture and to a committee of administration composed of the director of the station and of the representatives of all the bodies associated in the support of the station. Each year the Ministry of Agriculture calls to Rome all the directors of the stations and agricultural

laboratories to discuss the methods of analysis which must be adopted by the stations and laboratories, the studies which should be undertaken by several stations in coöperation, the results of investigations made, and the best manner of rendering the work of the stations and laboratories advantageous to agriculture. There are at present in Italy fourteen stations. Eight of these study general subjects with special reference to the peculiar conditions of the regions where they are located; six are almost exclusively engaged in work in special lines, such as dairying, wine-making, or sericulture, and are therefore called special stations.

GENERAL STATIONS.

Royal Agricultural Experiment Station at Turin, Prof. F. König, Director.—This station was established in 1871 and is autonomous. Its work is principally in the following lines: (1) Analyses of soils, waters, and fertilizers, with comparative experiments regarding their action on plant production; (2) study of the principal rock formations of the Piedmontese agricultural lands; (3) dissemination of the results of experiments by means of publications and lectures. The income of the station for 1891-'92 was $3,600. The scientific personnel includes a director and four assistant chemists.

Royal Agricultural Experiment Station at Milan, Prof. A. Pavesi, Director.—This station was established in 1871, in connection with the high school of agriculture. In 1879 it was moved to the high school of veterinary science of the same city. In January, 1891, it was reorganized. Its principal duties are: (1) Analyses and experiments with soils; (2) analyses and experimental determination of the relative value of different fertilizers; (3) experimental investigations on the raising of animals and the nutritive value of different forage plants; (4) microscopical examination of silkworm eggs and egg-testing; (5) dissemination of the results of experiments by means of publications and of public lectures. The station being under reorganization in 1891-'92 had only an income of $3,200.

Royal Agricultural Experiment Station at Modena, Prof. G. Cugini, Director.—This station was established in 1871, but was reorganized in November, 1879. It studies cereals and forage plants with reference to their introduction, acclimation, culture, physiology, pathology, and the adulteration, falsification, or spoiling of the plants, seeds, or commercial products (flour, bread, etc.).

A secondary line of work of the station bears upon the following points: (1) Analyses of fertilizers; (2) analyses of agricultural soils and the rocks of the subsoil; (3) chemical, microscopical, and botanical analyses of cereals and forage plants and of their immediate products; (4) analyses of potable and irrigation waters; (5) microscopical examination of silkworm eggs; (6) dissemination of agricultural knowledge, either by practical work given to students in the laboratories or by

public lectures. In 1888 a special section for the "control of seeds" was established.

The income of the station for 1891–'92 was $2,100. The scientific personnel of the station includes a director, assistant chemist, and assistant agriculturist, who are at the same time professors at the Technical Institute of the city, and a second assistant chemist.

Royal Agricultural Experiment Station at Florence, Prof. E. Bechi, Director.—This station was established in January, 1871, in connection with the Technical Institute of the city. It was made autonomous in October, 1889. The work of the station includes: (1) Analyses and experiments with soils; (2) analyses and experimental determination of the relative value of different fertilizers; (3) experimental investigations bearing on viticulture and olive culture; (4) dissemination of the results of experiments by means of publications and public lectures. The income of the station for 1891–'92 was $2,800. The scientific personnel of the station is a director, who is at the same time professor of agricultural chemistry at the Royal Technical Institute, at the Royal School of "Merciology" of Florence, and at the Royal Institute of Forestry of Vallombrosa, an assistant agriculturist, and an assistant chemist, professor at the Royal School of "Merciology."

Royal Chemico-Agricultural Experiment Station at Rome, Prof. P. Freda, Director.—This station was established in 1871 and reorganized in 1884. It is now located in the building of the Royal Agricultural Museum of Rome. The subjects of its studies are: (1) Analyses and experimental investigations of agricultural soils; (2) analyses and experimental determination of the relative value of fertilizers; (3) analyses of plants and of their products; (4) chemical and experimental investigations concerning the alimentation and the products of animals; (5) dissemination of the results of experiments by means of public lectures and publications. The income of the station for 1891–'92 was $4,720. The scientific personnel of the station includes a director and four assistants. This station has under its supervision nineteen experimental fields.

Royal Chemico-Agricultural Experiment Station at Palermo, Prof. V. Oliveri, Director.—This station was established in 1872 with the following principal subjects of work: (1) Physico-chemical examination of soils; (2) analyses and determination of the relative value of fertilizers; (3) experimental investigations upon the alimentation of animals and the nutritive value of forage plants; (4) experimental investigations on the culture and commercial quality of the sumac tree; (5) experimental investigations concerning œnology; (6) dissemination of the results of experiments by means of publications and lectures. Besides the above lines of work the station has undertaken the study of citrus fruits, olives, potable and irrigation waters, etc. The income of the station for 1891–'92 was $2,690. The scientific personnel includes a director, an assistant chemist, and an assistant agriculturist. One of the assistants is professor in a city school.

Royal Agricultural Experiment Station at Udine, Prof. G. Nallino, Director.—This station was established in 1870 in connection with the Royal Technical Institute. Its principal duties are: (1) Analyses and experiments with agricultural soils, (2) analyses and experimental determinations of the relative value of fertilizers, (3) experimental investigations concerning viticulture and œnology, (4) microscopical examination of silkworm eggs and egg-testing, (5) dissemination of the results of experiments by lectures and publications. The income of the station is only $1,400, but its director, agriculturist, assistant chemist, and assistant agriculturist are professors of the Royal Technical Institute, and the equipment of this institution is also used by the station.

Royal Agricultural Experiment Station at Forli, Prof. A. Pasqualini, Director.—This station was established in 1872 in connection with the Royal Technical Institute. Its principal lines of work are: (1) Analyses and experiments on agricultural soils, (2) analyses and experimental determinations of the relative value of fertilizers, (3) experimental investigations regarding viticulture and œnology, (4) microscopical examination of silkworm eggs, (5) investigations on forage and fiber plants (flax and hemp), (6) dissemination of the results obtained by means of lectures or publications. In this station, as in that of Udine, the personnel and the equipment are those of the technical institute and therefore the income is only $1,720. Besides the director there are an assistant chemist and an assistant agriculturist.

SPECIAL STATIONS.

Royal Œnological Station at Asti, Prof. M. Zecchini, Director.—This station was established in 1872 with the following lines of work: (1) Analyses of grapes at different periods of maturation, and investigations of their diseases; (2) chemical and microscopical investigations on the phenomena of fermentation; (3) analyses of musts and wines with reference to their composition, adulterations, or diseases; (4) analyses of soils destined for grape culture, and investigations on the kinds of fertilizers to apply for different varieties, exposures, and locations; (5) research on the best methods of vinification, preservation of wine, examination of wine, and wine-making machinery; (6) chemical study of the grapevine; (7) dissemination of the results obtained from experiments by means of publications or lectures. The income of the station is $3,500. It has a director and two assistant chemists and viticulturists. There is also an assistant for the nursery of American vines, whose salary comes from other funds.

Royal Dairy Station at Lodi, Prof. C. Besana, Director.—This station was established in 1871, but was reorganized in 1879. The subjects of its investigations are: (1) Physical and chemical properties of the different qualities of milk at various periods of preservation and preparation; (2) milk adulteration and its effects; (3) influence of temperature on

the conservation of milk and the manufacture of cheese and butter; (4) influence of fat content on the manufacture and keeping quality of cheese; (5) effects of different methods of heating milk, and of the coagulating, coloring, and preserving substances; (6) alterations of dairy products and means of prevention and remedies; (7) machinery for cheese and butter-making; (8) other investigations related to this industry. The income of the station is $2,680. It has a director and two assistants.

Royal Station and Laboratory of Cryptogamic Botany at Pavia, Prof. G. Briosi, Director.—This station was established in 1871 in connection with the Botanical Institute of the Royal University. It has four lines of work: (1) The development of systematic and morphological knowledge regarding the parasitic cryptogams of plants and of animals; (2) investigations as to the best means for the prevention of these parasites, for stopping their development and dissemination, and for diminishing their injurious effects; (3) solution of questions addressed to the station by public or private parties; (4) dissemination of the results by lectures and publications. The station admits students to its laboratory. Besides a director there is a special assistant in the laboratory. The personnel and equipment of the station are those of the University. The income from the Ministry of Agriculture is about $2,000.

Royal Station of Sericulture at Padua, Prof. E. Verson, Director.—This station was established in 1871 for the purpose of (1) studying the essential conditions of success in raising silkworms, (2) studying the laws of normal nutrition of silkworms by means of physical and chemical experiments, (3) investigating the causes of the different diseases of silkworms and of the mulberry tree, (4) preparing and disseminating sound eggs and making microscopical examinations for private parties, (5) experimenting with new races of silkworms and new instruments for sericulture, (6) undertaking any study and investigation that might help silk culture, (7) disseminating the results obtained by means of publications and lectures, (8) gathering news of the silk industry in all parts of the kingdom and promoting its increase by assisting agricultural associations and private growers. The income of the station was $3,580 for 1891–'92. Besides the director there are an assistant director and an assistant.

Royal Station of Agricultural Entomology at Florence, Prof. A. Targioni-Tozzetti, Director.—This station was established in 1875 in connection with the Museum of Natural History of the Royal Institute for Higher Studies. Its objects are: (1) To investigate the nature of such insects and animals as are injurious to cultivated plants and to agricultural products, and to study their biology and the means of preventing and remedying their damages; (2) to disseminate the results obtained by means of publications or lectures. The income of the station is about $2,000. The personnel and the equipment are those of the laboratory of zoölogy of invertebrate animals of the institute.

Royal Station of Vegetable Pathology at Rome, Prof. G. Cuboni, Director.—This station was established in 1887 in the building of the Royal Agricultural Museum. Its principal objects are: (1) Experimental investigations on diseases of cultivated plants and on the means of prevention and treatment, (2) investigations on microörganisms that produce alterations in agricultural products and on the means of prevention and treatment, (3) dissemination of the results of experiments by means of lectures and publications. In 1891–'92 the income of the station was $2,600. Besides the director there are two assistants.

Laboratory of "Zymotechnics" at Rome, Dr. C. Forti, In Charge.—This laboratory was established a short time ago in the building of the Agricultural Museum at Rome, for the investigation of fermentations in their relation to agricultural industries. Important studies on the ferments of unsound wines have already been started.

Chemico-agricultural laboratories.—These laboratories are connected with the chemical laboratories of universities or technical institutes. Besides the work that they must do for the institutions of which they are a part, they make analyses of agricultural products for public and private parties, for which they receive a small compensation according to an official tariff; they give advice and instruction on agricultural subjects free of charge; moreover they carry on investigations on special subjects, but only to a limited extent. These laboratories are not established by the Ministry of Agriculture, which, however, has supervision over them, and allows them a subsidy amounting to about $200 a year. The equipment and the personnel are those of the institutions with which they are connected.

The laboratories now in operation are located as follows: At the Technical Institute, Bologna, established in 1871, Prof. A. Casali, director; at the Royal University, Siena, established in 1872, Prof. C. Giannetti, director; at the Technical Institute, Pesaro, established in 1871, Prof. F. Duprè, director; at the University of Pisa, established in 1886, Prof. F. Sestini, director; at the University, Perugia, established in 1883, Prof. G. Bellucci, director; at the Technical Institute, Caserta, established in 1888, Prof. L. O. Ferrero, director. In the schools of viticulture and œnology at Conegliano and Alba are special laboratories for analyses connected with grape culture, wine-making, and related industries.

Experimental cellars.—Their object is to study the best methods for preparing wines of good keeping qualities to answer the needs of the trade. For this purpose only grapes of the regions where the cellars are established are worked. There are at present cellars at Barletta, Riposto, and Noto, the directors of which are, respectively, Profs. A. Fonseca, G. Notari, and R. Perrotta. Another cellar will be opened this year at Velletri. These cellars are to be moved to other localities as soon as the work for which they were established has been accomplished.

Experimental oil mills.—Their object is to investigate, apply, and disseminate the best methods for the preparation, purification, and preservation of oils made from olives of the regions where the experiments are carried on. There are at present two of these institutions—one at Portici in connection with the High School of Agriculture, directed by Prof. E. Mingioli, and one at Palmi, directed by Dr. Bracci. These institutions also make analyses of olives, oils, and by-products, and give special lectures on olive culture and oil-making.

Sericultural observatories.—These observatories must execute microscopical examinations of silkworm eggs and moths at the request of private parties, conduct a rational culture of silkworms, and if necessary prepare the eggs; in brief, they should contribute to improve sericulture by practical example and advice. There are at present forty three of these observatories distributed throughout the different regions of Italy. Their directors have received their instruction in the silk culture station of Padua.

Dairy observatories.—The object of these institutions is to promote the improvement of the dairy industry by the dissemination of knowledge regarding good practices and instruments for cheese and butter-making, by testing adulterations of milk and of its products, and by collecting such new facts as may be applicable to the practice of dairying. There are at present ten observatories, the directors of which have received their instruction at the Dairy School of Lodi.

Viticultural observatories.—The object of these observatories is the study of the adaptation of resistant American vines to the soil and climate of Italy, and of the success of grafting. These observatories were started by Prof. Cavazza and there are several in Piedmont. Many experimental fields and nurseries of American vines have been established all over Italy.

Experimental fields for the treatment of Phylloxera.—In order to make special investigations in regard to the modes and time of treatment, and especially the quantity of carbon bisulphide to apply to obtain the best results, experimental fields were established at Messina, Reggio di Calabria, and Sassari. Important results have already been obtained, showing that in certain cases this method of treatment may be applied with success.

Œnotechnical stations in foreign countries.—In order to give a more extended development to the trade in Italian wines in foreign countries, it was necessary to have a closer knowledge of the usages and needs of foreign markets. Special stations for this purpose were established in other states in 1884. Their duty is to find out what types of Italian wines are acceptable in their localities and what foreign wines resembling Italian wines are most largely consumed in these regions. The directors of the stations should also collect data in regard to the wine production and trade of each country, investigate the causes which prevent the sale of Italian wines, and give advice both to the Govern-

ment and to wine makers how best to promote exportation. They must send a report to the Ministry of Agriculture every two months. Some of these stations have a depot for wines sent to them by different Italian producers. There are at present five of these stations in foreign countries, at Berlin, Munich, London, Lucern, and Buenos Ayres, the respective directors of which are G. Ferrario, G. Briolini, G. Rossati, A. Plotti, and B. Trentin. Large benefits have been derived from these stations in the extension of the trade in Italian wines in foreign countries.

Zoötechnical stations and depots.—Their object is the improvement of the races of animals by means of scientific investigations and practical experiments, and the giving of instruction on the proper manner of raising animals. There are at present three of these depots connected respectively with the High School of Agriculture at Portici, the School of Zoötechnics at Reggio d' Emilia, and the Zoötechnical Institute at Palermo. There are also seven stations in connection with the practical schools of agriculture. A project is on foot to establish a larger number of them.

Fish culture stations and laboratories.—A station for fish culture was established in 1887 at Brescia under the direction of Prof. Beetoni, with an income of about $2,600. Another similar station has been temporarily established in the Agricultural Museum of Rome, but will soon be moved to a permanent location in central Italy. Special laboratories for artificial fecundation and incubation have been established at Belluno, Treviso, and Verona.

Central weather bureau; meteorological observatories and stations.—The meteorological and geodynamical work of the Italian Government is under the scientific direction of a special board, composed of delegates of the Ministries of Agriculture, Industry, and Commerce, of Public Instruction, of the Navy, and of Public Works. A central bureau, located at Rome, is in charge of the work and has under its control all of the observatories and stations established in the State.

Meteorological observations are made in observatories proper, and in thermo-udometric stations. The former as a rule make all observations relating to meteorology, but those observatories which are connected with schools of agriculture confine their attention to agricultural meteorology; the thermo-udometric stations attend only to the observations of temperature and rainfall. At the end of the year 1891 there were two hundred and eighty-eight observatories, and about six hundred thermo-udometric stations. The director of the work is Prof. Tacchini.

Sanitary station and houses in the Alpine region.—A sanitary station at Brescia in Collio receives boys and girls affected by "pellagra" and malaria, who are sent to this Alpine region for one month to restore them to health. There are also forty sanitary houses in the Province of Bergamo, north Italy, at which persons affected with pellagra are

treated. Pellagra is a very painful disease of the skin, which is due principally to the use of spoiled maize and to unfavorable hygienic conditions. The Ministry of Agriculture does not establish these institutions, but helps them with subsidies of money.

Publications.—The department of the director general of agriculture publishes the Annals of Agriculture (*Annali di Agricoltura*) and the Bulletin of Agricultural News (*Bolletino di Notizie Agrarie*).

The agricultural experiment stations and schools publish yearly reports (*Annali*). During the year, however, the results of their investigations or experiments are published in the official publications of the Ministry of Agriculture, in the Journal of the Agricultural Experiment Stations, or in other periodicals. The Journal of the Agricultural Experiment Stations (*Le Stazioni Sperimentali Agrarie*) is issued once a month and contains original articles contributed by the officers of the schools and stations, and a review of works published in Italy and in foreign countries on matters bearing on scientific agriculture and rural industries. The editorship of this journal is held for two years by each director of the stations.

The central weather bureau publishes annals and bulletins. Other important publications are issued by the royal academies of agriculture, such as those of Florence, Turin, Verona, and Pesaro, and the agricultural and horticultural associations of Milan, Naples, Florence, etc.

The official publications of the Ministry, schools, stations, and agricultural associations may be obtained on application.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY.

E. W. ALLEN, *Editor.*

Chemical division of Rhode Island Station, H. J. WHEELER, (*Rhode Island Sta. Report for 1891, pp. 82–86*).—Brief remarks on the work of the year; additions to the laboratory; and analyses of water, grapes sprayed with Bordeaux mixture, honey, sugar beets, wheat bran, and gluten meal.

Report of chemist of New York State Station, L. L. VAN SLYKE (*New York State Sta. Report for 1891, pp. 216–455*).—This includes a summary of the laboratory work of the year, a statement showing the lines of work assigned to the several assistant chemists, a list of the bulletins prepared by the chemist during the year, experiments in the manufacture of cheese (see p. 274), comparison of dairy breeds of cattle with reference to production of butter and cheese (see p. 273), comparison of methods of creaming milk by setting and by centrifugal machine (see p. 273), analyses of materials used in spraying plants and of sprayed grapes (see p. 55), explanation of terms used in connection with fertilizer analyses, and analyses of commercial fertilizers (see p. 246). The chemical work of the station has been mainly confined to investigations connected with dairy problems and analyses of fertilizers. The total number of determinations made during the year is given as 14,524.

METEOROLOGY—WATER.

Meteorological observations, C. D. WARNER (*Massachusetts Hatch Sta. Meteorological Buls. Nos. 43 and 44, July and August, 1892, pp. 4 each*).—A daily and monthly summary of observations for July and August at the meteorological observatory of the station.

Meteorological record, 1891, R. D. NEWTON (*New York State Sta. Report for 1891, pp. 498–514*).—Tabulated details of observations of rainfall, wind, sunshine, and temperature of the air. The yearly summary is as follows: *Air temperature* (degrees F.).—Maximum 95, minimum 2.5. *Precipitation.*—Total (inches) 27.52. *Wind.*—Prevailing direction SW

to NW. *Sunshine* (per cent of possible).—Maximum 59 (during September), minimum 28.4 (during November), mean 41.4.

Meteorological summary for North Carolina, May and June, 1892, H. B. BATTLE, C. F. VON HERRMANN, AND R. NUNN (*North Carolina Sta. Buls. Nos. 86c and 86d, June 30 and July 31, 1892, pp. 16 each, maps 2*).—Notes on the weather, and tabulated daily and monthly summaries of observations by the North Carolina weather service, coöperating with the U. S. Weather Bureau. Observations for May and June, 1882–'92, are tabulated. The bulletin for May is illustrated with maps showing the isothermal lines and the rainfall at the stations in different parts of the State.

The mean temperature for May was 66.8° F.; the normal is 66.9°. * * *

The warmest May during twenty years occurred in 1880 and 1887, when the monthly mean for the State was 70.3°; the coolest May was that of 1877, mean 61.7. * * *

The average precipitation for the State was 3.6 inches, which is 0.6 inch below the normal. * * *

During the past twenty-one years the wettest May occurred in 1873 (average 7.11 inches), the driest in 1880 (average 2.03 inches). * * *

The mean atmospheric pressure for the month was slightly above the normal.

The monthly mean temperature for the State during June was 1.1° above the normal for twenty years, which is 74.4°. The highest mean temperature for June of which there is record occurred in 1890—77.6°, the lowest in 1878—70.2°. The highest temperature this month was 103°, on the 24th, at Southern Pines, which is the highest on record for June. The lowest this month was 48°, on the 14th, at Douglas. * * * The precipitation was 2.56 inches above the normal. The average over the State was 6.9 inches. * * * The greatest rainfall reported was 17.02 inches, at Rock House farm (Horse Cove), which is the greatest amount ever recorded in June. * * * The average atmospheric pressure for the month was a little above the normal. * * * A tornado passed through the Cashie Neck section of Bertie County on Sunday, June 5. Its path was about 400 yards wide and it traveled about 12 miles. It moved in an easterly course. * * * At Weldon, on the 25th, the heaviest hail since June 8, 1860, occurred. The stones were about the size and somewhat the shape of hens' eggs; one weighed 362 grains. The precipitation between 5:17 and 5:43 p. m. was 1.17 inches, and it is thought that 1 inch occurred in ten minutes.

Meteorological observations at South Dakota Station (*South Dakota Sta. Bul. No. 31, May, 1892, pp. 8*).—Notes on the weather, and tabulated data regarding temperature, pressure, precipitation, and direction of wind for May-December, 1888, and for each month, and for the growing seasons of 1889, 1890, and 1891. The observations for three years (1889–'91) may be summarized as follows: *Pressure* (inches).—Maximum 28.96, minimum 27.44, average 28.30. *Air temperature.*—Maximum 101, minimum 35, average 43. *Precipitation.*—Total 48.88 inches, average per year 16.29 inches, average per day (175) 0.28 inch, rainy days 175. *Wind.*—Number of days in each direction, N 407, S 473, E 18, W 20.

Meteorological observations for April-September, 1889, 1890, and 1891.

Year.	Precipitation, total.	Number of rainy days.	Average precipitation per rainy day.	Per cent of the year's precipitation.	Prevailing direction of wind.
	Inches.		*Inches.*		
1889	10.69	45	0.24	77	S
1890	16.09	42	0.38	85	S
1891	11.03	40	0.28	68	SE
Average	12.60	42	0.30	77	S

Meteorological summary, L. F. KINNEY (*Rhode Island Sta. Report for 1891, pp. 98-100*).—Tabulated monthly summaries of observations during 1889, 1890, and 1891 of temperature, barometric pressure, rainfall, prevailing winds, and cloudiness. The yearly summary for 1891 is as follows: *Pressure* (inches).—Mean 29.96. *Air temperature* (degrees F.).—Mean 48.9. *Precipitation.*—Total (inches) 49.64.

SOILS.

W. H. BEAL, *Editor.*

Geology of north Louisiana, O. LERCH (*Louisiana Stas. Special Report, part I, pp. 52, figs. 7*).—This is a report of preliminary work on a geological and agricultural survey of the State, and is confined to a discussion of observations on the topography, geology, mineralogy, and soils of the hills of north Louisiana, accompanied by analyses by M. Bird of well, spring, and artesian waters, iron ores, lignites, natural phosphates, marls, soils, and subsoils.

This survey has been undertaken mainly in the interest of agriculture. To this end soils have been classified and carefully mapped out, typical samples taken, character of vegetation noted, drainage systems established, and general elevation above sea level observed, with other special peculiarities. The soils have been sent to the laboratories of the station and are now undergoing physical and chemical examination. Later a special report will be made upon "the soils of the State and their composition and wants, with best modes of supplying the latter." This report will cover the State and be beneficial to every planter and farmer.

Incidentally the geology of the State is being carefully studied, so as to locate each section of the State in its proper geological horizon. Especial attention is also being paid to the mineral resources of the State, particularly those which may be of agricultural value, such as phosphates, marls, gypsum, etc. * * *

That portion of north Louisiana, a preliminary study of which is embraced in this report and which is located in one of the most interesting physiographic regions of the United States, stretches from the Ouachita River on the east to the Red River on the west, and from the Vicksburg, Shreveport, and Pacific Railroad on the south to the south boundary line of the State of Arkansas on the north. Small as this section is when compared with the entire State of Louisiana, and as uniform and simple as its surface configuration and its structural geology seem to be, it presents so many and so varied problems that a detailed and extensive study of this region will be required to solve them, and this paper must therefore be considered a preliminary report, subject to changes as developed by future investigations.

Soil temperatures, 1891, R. D. NEWTON (*New York State Sta. Report for 1891, pp. 515–521*).—Tabulated data of tri-daily observations at the surface and at depths of from 1 to 18 inches, for each month from April to October, inclusive.

FERTILIZERS.

W. H. BEAL, *Editor.*

Analyses of home mixtures and incomplete fertilizers, E. B. VOORHEES (*New Jersey Stas. Bul. No. 88, July 8, 1892, pp. 19*).

Synopsis.—A continuation of inquiries carried on since 1889 regarding the use of fertilizers in New Jersey, and the composition and cost of home mixtures and incomplete fertilizers. It has been shown that uniform mixtures of fertilizing materials can be prepared by farmers at an average cost per ton of over 25 per cent less than that of manufactured brands, a saving of at least $330,000 per year for the State.

This bulletin contains suggestions as to the economical purchase and rational use of fertilizers; formulas and analyses of home mixtures for different crops, with remarks on their cost; trade values of fertilizing ingredients for 1892; the average cost per pound of plant food elements in fertilizer supplies; and analyses of 87 samples of incomplete fertilizers, including nitrate of soda, sulphate of ammonia, dried blood, dry ground fish, tankage, boneblack, bone ash, South Carolina rock and other mineral phosphates, muriate of potash, kainit, sulphate of potash, and double sulphate of potash and magnesia.

As regards the use of fertilizers in New Jersey, statistics gathered by the station show that at least $1,346,000 was spent for commercial manures in 1891. Of this total, over $1,000,000 was spent for complete manures and the balance for nitrogenous materials, boneblack, South Carolina rock superphosphate, ground bone, and the various potash salts. In addition to these concentrated and direct forms of plant food, there is a large annual purchase and consumption of natural manures, which are to a certain extent indirect in their action, such as New York or Philadelphia horse manure, wood ashes, marl, lime, etc. The bulk of these purchased manures of either class is used in truck or special-crop farming, where annual and heavy dressings are made to all crops or to some special or money crop in the rotation, as potatoes, sweet potatoes, tomatoes, asparagus, fruit, or berries.

As a result of the station's investigations, it has been shown that the cost per pound of nitrogen, phosphoric acid, and potash in raw or unmixed materials is less than the station's valuations, while that of the same elements in mixed fertilizers is at least 25 per cent greater.

The difference between these two methods of buying would amount, on the basis of last year's sales, to over $336,000. This sum is consumed not in manufacturers' profits alone, as some suppose, but in the transportation of a vast amount of absolutely worthless material, in agents' commissions, and in credit.

An examination of eight home mixtures showed them to be uniform and of good mechanical condition. A comparison of their average cost per ton with that of eight special brands showed "a difference of $12.14 per ton in favor of the home mixture, which contained at least $2 worth of plant food in excess of that in the manufactured brand."

Coöperative field experiments with fertilizers on corn, J. D. TOWAR (*Rhode Island Sta. Report for 1891, pp. 35–81*).—Experiments begun in 1890 and described in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 530) were continued in 1891, "with the same amount and kind of fertilizers and as far as possible on the same ground." Notes and tabulated data are given for experiments on eight farms in different parts of the State. The results are summarized as follows:

The plats manifested nearly all the same conditions the second year that were noticed the first year of the experiment.

While in four cases in 1890 potash appeared the most deficient, it has in no case upon a second trial been found so much lacking as phosphoric acid. It may be stated in general that our Rhode Island soils are probably more deficient in available phosphoric acid than in potash, which is accounted for by the fact of their granitic origin and consequent natural supply of potash.

With very few exceptions the two-thirds rations of nitrogen have given the best results; as a rule the application of small quantities has given very small profits and the application of large amounts has often resulted in financial loss.

Of the three forms of nitrogen, nitrate of soda has upon the whole proved the most profitable and sulphate of ammonia the least.

In most of the plats where dried blood was applied the corn ripened earlier and showed, when compared with the nitrate of soda and sulphate of ammonia plats, a greater relative yield than in 1890. This gain may be due to the fact that the dried blood contained, in addition to the organic nitrogen, a small amount of phosphoric acid, and this amount was unusually great in the blood used in 1891. The phosphoric acid may have increased the yield. Another cause for the increased yield might be—since nitrification of dried blood is somewhat slow—that in all probabilty some of the nitrogen applied on these plats in 1890 was unused until 1891.

The most profitable fertilizer used in these experiments was composed of a mixture per acre of about 350 pounds dissolved boneblack and 130 to 150 pounds muriate of potash, with 300 pounds nitrate of soda or 230 pounds sulphate of ammonia or 440 pounds of dried blood—a fertilizer containing about 45 pounds nitrogen, 75 pounds potash, and 54 pounds phosphoric acid per acre. * * *

It seems advisable in preparing a fertilizer to use the above forms of potash and phosphoric acid and apply a part of each of the forms of nitrogen—say one half of nitrate of soda—to give the corn an early start, and the other half of sulphate of ammonia or dried blood, or both, to help the corn along during the latter period o its growth.

The average relative weights of corn and stover from eighteen fields of this variety of corn (white-capped) has been determined and found to be 57 pounds of stover to each bushel (70 pounds), that is to say, 100 pounds of corn in the shock contains 55 pounds of corn and 45 pounds of stover.

Analyses and valuations of fertilizers and farm products, L. L. VAN SLYKE (*New York State Sta. Report for 1891, pp. 401–455*).—This includes an explanation of the chemical terms used in fertilizer analysis; notes on the commercial valuation of fertilizers; compiled analyses, with valuations, of various fertilizing materials and farm products; and

tabulated analyses of 224 commercial fertilizers inspected under the provisions of the State fertilizer control.

For convenience, as a present and future reference, it is considered desirable to present a rather full compilation of the analyses of various commercial fertilizing materials and of various farm products, giving their fertilizing constituents and valuation.

There are many other farm products which it would be desirable to present in these tables, but their omission is rendered necessary by the fact that there have as yet been no complete analyses of their fertilizing constituents. This station proposes in the near future to make such analyses as will fill up many of these gaps. The analyses presented have been compiled from every accessible reliable source, such as the reports of various experiment stations, standard works upon agriculture, and especially König's invaluable compilation.

Fertilizer inspection in Rhode Island, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Bul. No. 16, May, 1892, pp. 15*).—This includes the text of the State fertilizer law, with comments; the trade values of fertilizing ingredients in crude stock, with notes on valuation; and tabulated analyses of 24 samples of fertilizing materials, including compound fertilizers, ground bone, and wood ashes.

The principal provisions of the fertilizer law passed in January, 1892, are as follows:

All manurial substances sold within the State for $10 or more per ton, including agricultural chemicals, fertilizer stock, wood ashes, bone, commercial fertilizers, etc., must be accompanied by a guaranty [setting forth the weight of material in each package], the percentage of nitrogen, of actual potash (K_2O) soluble in distilled water, and of soluble, reverted, and insoluble phosphoric acid.

Each manufacturer or importer must send a guaranty of each brand sold by him, together with the names and addresses of his agents in this State, to the chemist of the Rhode Island Station at Kingston.

Analysis fees must be paid on or before April 1 in each year to the general treasurer, Providence, Rhode Island. * * * The amount of the fee is $6 for each fertilizing ingredient contained or claimed to exist in said material. * * If the manufacturer or importer has paid this fee the dealer is no longer liable for the payment of the same.

Parties using leather in any form as a component of a fertilizer are obliged to state the fact on the label by which it shall be accompanied.

[The inspection is under the supervision of the State board of agriculture, the chemist of the Rhode Island Station being authorized, either in person or by deputy, to collect and analyze the various fertilizers offered for sale in the State, and the director of the station to publish the analyses, together with the commercial value per ton.]

For all the purposes of this act fertilizers shall be considered as distinct brands when differing either in guarantied composition, trade-mark, or name, or in any other characteristic method of marking of whatever nature.

It is made the duty of the secretary of the State board of agriculture to prosecute every person violating the provisions of the law [the penalty being for the first offense $50 and for each subsequent offense $100], but there shall be no prosecution in relation to the quality of the fertilizer if the same shall be found to be substantially equivalent to the guarantied statement made by the manufacturer.

Analyses of commercial fertilizers, 1892, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Bul. No. 17, June, 1892, pp. 7*).—Tabulated analyses of 18 samples of commercial fertilizers.

Commercial fertilizers, M. A. SCOVELL (*Kentucky Sta. Bul. No. 41, July, 1892, pp. 23*).—A popular discussion of the nature, use, and sources of fertilizers is given, together with analyses and valuation of 79 brands of fertilizers inspected during 1892.

Inspection of fertilizers in Michigan, R. C. KEDZIE (*Michigan Sta. Bul. No. 86, July, 1892, pp. 11*).—Notes on valuation, text of the State fertilizer law, and analyses of 47 samples of commercial fertilizers.

Analyses of commercial fertilizers (*South Carolina Sta. Bul. No. 6, n. ser., July, 1892, pp. 13*).—Trade values of fertilizing ingredients for the season of 1891–'92, and analyses of 243 samples of commercial fertilizers.

Manures and some principles in farm-manuring, G. L. TELLER (*Arkansas Sta. Bul. No. 19, May, 1892, pp. 55*).—A bulletin of popular information for the use of the farmers of Arkansas. The subjects discussed are, the chemical elements which enter into plant growth, geology and agriculture, classification of soils, humus, living organisms of the soil, soil water, the purpose of manures, nitrogen, phosphoric acid, potash, lime, ashes, bone, barnyard manures, composts, and commercial valuation of manures.

FIELD CROPS.

A. C. TRUE, *Editor*.

Grasses and forage plants for Mississippi, S. M. TRACY (*Mississippi Sta. Bul. No. 20, February, 1892, pp. 17*).—Notes on the culture and uses of the following species of grasses and forage plants which have been successfully grown in experimental tests at the station: Redtop (*Agrostis vulgaris*), Australian blue grass (*Andropogon erianthoides*), smooth brome (*Bromus inermis*), rescue grass (*Bromus unioloides*), Indian beard grass (*Chrysopogon serrulatus*), Bermuda grass (*Cynodon dactylon*), orchard grass (*Dactylis glomerata*), terrell grass (*Elymus virginicus*), teosinte (*Euchlæna luxurians*), the rye grasses (*Lolium* spp.), Munro grass (*Panicum agrostoides*), spreading panic (*Panicum proliferum*), crab grass (*Panicum sanguinale*), water grass (*Paspalum dilitatum*), carpet grass (*Paspalum platycaule*), timothy (*Phleum pratense*), Texas blue grass (*Poa arachnifera*), Kentucky blue grass (*Poa pratensis*), Johnson grass (*Sorghum halepense*), sorghums (*Sorghum vulgare*, vars.), beggar weed (*Desmodium molle*), cowpeas (*Dolichos sinensis*), winter vetch (*Lathyrus hirsutus*), Japan clover (*Lespedeza striata*), burr clover (*Medicago maculata*), alfalfa (*Medicago sativa*), melilotus (*Melilotus alba*), Mexican clover (*Richardsonia scabra*), scarlet clover (*Trifolium incarnatum*), red clover (*Trifolium pratense*).

When the Agricultural College of Mississippi was organized in 1880, one of the first lines of work undertaken was the cultivation of grasses and forage plants, both for the production of hay as a part of good farming and for the restoration of the worn-out and exhausted clay hills which then formed a large part of the college farm. When the experiment station was established in 1888, one of the first orders

passed by the board of trustees was for an investigation of the comparative values of different plants for the double purpose of providing hay and pasture and for improving the condition of the soil.

As cotton is now the principal crop grown in the State and will doubtless continue to be so for many years to come, the effect which a forage crop has on the soil has received fully as much attention as has the value of hay or pasture which may be secured. The part of the plant which is above the soil is needed as food for stock, but in many cases that part below the surface of the ground is of still greater value as food for future crops. * * *

Acting upon these ideas, we have procured seed of more than three hundred species, many of them being from northern India, Australia, Russia, and other foreign countries. We also secured seeds of a number of species from the arid regions in the Southwest, and have taken special pains to secure seed of such native species as seem to be of value. Many of these were received in very small quantities, and we have been obliged to grow two or three crops before securing enough seed for field tests, but thirty-nine kinds have been planted on areas of from 1 to 30 acres each, and several upon much larger fields.

With so many species, coming as they did from all parts of the world, it was not expected that all or even many of them would prove valuable for cultivation under the peculiar climatic and soil conditions which exist here, where the growing season for different plants extends nearly through the year, and where protracted summer drouths and excessive winter rains make it necessary that hay and pasture fields should be able to resist great atmospheric extremes. A large majority of the native forage plants in this region commence their growth late in the spring, but from about the first of April to December the pastures are abundant, and certain kinds of hay may be cut at any time from June to November. The great desideratum for this region is a plant which will make a fair crop for pasture during the cool and rainy months of winter and one which will leave the soil in a better condition at the close of the year. * * *

It is impossible to find any one forage plant which continues an active growth through the year. For this reason a mixture of two or three kinds will usually prove to be better than will either one when planted alone, and when possible one plant in the mixture should belong to the clover family. No one, two, or three varieties will succeed best in all parts of the State, and the choice for each farm must depend on local conditions. Most of the true grasses are affected more by moisture than by other differences in the soil, while most of the clovers are affected more by the amount of lime. For general cultivation we regard Bermuda, lespedeza, melilotus, red clover, and Johnson grass as the five best species for this State, and value them in the order in which they are named. For hay alone, Bermuda, lespedeza, and Johnson grasses are the best, while for pasture we have found nothing better than Bermuda grass, orchard grass, and burr clover for the lighter and more sandy soils of the pine woods region. Where a fertilizing crop is wanted for immediate effect there is nothing equal to the cowpea, and when the land is to remain without cultivation for a year or more melilotus, red clover, or lespedeza is the best crop that can be sown. If the land contains an excess of lime melilotus is to be preferred, but if deficient in lime and somewhat barren lespedeza is the better crop. On lime soils that are in fair condition red clover will give excellent results as a fertilizer, and will also give two crops of hay, which will be of more value than that from melilotus or lespedeza.

There are about two hundred species of grasses which are native to this State and probably one half the number can be found on every farm. Many of these are of great local value and their growth should be encouraged wherever they promise to be permanent.

Grasses of Tennessee, part I, F. LAMSON-SCRIBNER (*Tennessee Sta. Bul. vol. v, No. 2, April, 1892, pp. 29–119, figs. 75*).—The author

divides his work, which is intended to be preliminary to a more detailed report, with descriptions and as far as possible illustrations of all the grasses of the State, into four sections. Section 1 is an alphabetical list of the native and cultivated grasses found within the State. There are mentioned about one hundred and fifty species and varieties, with figures illustrating twenty-seven of the more important ones. Under each species is given a brief sketch of its habit, character, and economic value. In addition to the botanical names there are given over six hundred common names, with the botanical equivalent of each. Section 2, by means of 45 figures, fully illustrates all the terms used in the technical description of grasses, and often the figures serve to illustrate the species they represent. The advantage of this as compared with the ordinary glossary will be readily seen. Section 3 gives in detail the characters of the Gramineæ and a key for the determination of the various genera. Section 4 contains a list of the works in whole or part devoted to grasses, which may be found at the station.

Experiments with potatoes, 1891 (*New York State Sta. Report for 1891, pp. 480–487*).—Descriptive notes and tabulated data for 33 of the newer varieties of potatoes, and an account of spraying experiments with Bordeaux mixture and an ammoniacal solution of copper for potato blight. Both fungicides were effective, but the best results were obtained with the Bordeaux mixture.

Sorghum, W. P. WHEELER (*New York State Sta. Report for 1891, pp. 208–215*).—Sixteen varieties of sorghum are reported upon, 10 of which were grown from seed selected from individual canes in 1890, and 4 others from seed received from the U. S. Department of Agriculture. Data are tabulated for these 16 varieties and for the analyses of the juice. In 1890 sorghum grown on land top-dressed with carbonate of lime averaged a higher percentage of sugar than that from land untreated. To test this further, in 1891 2 plats, A and C, received an application of crude precipitated carbonate of lime at the rate of 6,000 pounds per acre, and two others, B and D, were left untreated.

> No differences of any consequence in yield or maturity were noticed. * * * The average of all the determinations from plats A and C was, specific gravity of juice 1.0593 and cane sugar 9.36, and from plats B and D, specific gravity 1.0592 and cane sugar 9.39. From these results it is quite plain that for this season at least there was no advantage in favor of an application of lime.

Field and plat experiments, C. O. FLAGG and J. D. TOWAR (*Rhode Island Sta. Report for 1891, part II, pp. 22–35*).

Synopsis.—The experiments reported were in the following lines: (1) A comparison of winter and spring applications of ashes to newly seeded meadows; (2) rye following a two-years' fertilizer experiment with corn; (3) fertilizer, variety, and cultural experiments with oats, and experiments with the Jensen hot water treatment for smut of oats; (4) variety tests with barley, wheat, sorghum, sugar beets, flax, hemp, pearl millet, Jerusalem corn, and Kansas King corn; and (5) fertilizer and variety tests with corn.

Winter and spring applications of ashes to a newly seeded meadow (p. 22).—On one third of an acre of an old sheep pasture seeded to a mixture

of timothy and redtop in 1890, one half ton of Canada ashes was applied on the snow January 6. On a parallel plat of the same dimensions an equal quantity of the same ashes was applied April 10. The yields of hay were as follows: Winter application 1,906 pounds, spring application 1,497 pounds—a gain of 409 pounds, or 27 per cent in favor of the winter application.

Rye following a two-years' fertilizer experiment with corn (pp. 22-24).—The results are tabulated of growing rye on 24 plats which in experiments with corn in 1889 and 1890 had received boneblack, muriate of potash, sulphate of ammonia, and seaweed, either singly or combined. These results indicated that the more soluble forms of fertilizer had been almost completely exhausted; that bone was more lasting than boneblack; and that a combination of nitrogen, potash, and stable manure was better for rye than stable manure and phosphoric acid.

Fertilizer, cultural, and variety experiments with oats, and the Jensen hot water treatment for smut of oats (pp. 24-27, 30, 31).—Nine plats, used in 1890 for experiments with Earle's Horsefoot guano and mixed minerals on oats, were manured with seaweed (applied part in September and part in the winter and spring) at the rate of about 9 cords per acre, and were again seeded to oats, one half in drills and the other half broadcast. The tabulated results show no benefit from the fertilizers applied in 1890 and indicate a loss from exposure of the seaweed applied in September. Very little difference in results was observed between the drilled and broadcasted plats.

Tabulated data are given for tests of 27 varieties of oats, the majority of which were grown from seed donated by the Ontario Agricultural College.

Two-ounce lots of 6 varieties of oats were treated before sowing for five minutes with water at 133°-135° F., duplicate lots being left untreated. "The treated oats showed a gain in yield of grain of 8.18 bushels per acre, or 14.7 per cent; and a gain of 260 pounds of straw, or 8.6 per cent." The treated plats were practically free from smut, while the untreated oats contained from 3 to 4 per cent of smutted heads.

Variety tests of various field crops (pp. 27-30).—Tabulated data for tests of 14 varieties of oats and 10 of wheat, and brief notes on experiments with sorghum, sugar beets, flax, hemp, pearl millet, Jerusalem corn, and Kansas King corn.

Fertilizer and variety tests of corn (pp. 31-35).—Six fourth-acre plats of light, sandy loam were fertilized with barnyard manure, a compound fertilizer, and mixtures of dissolved boneblack or ground bone with nitrate of soda and muriate of potash. The results are given in a table. The yields per acre of 2 varieties of corn are also tabulated.

Coöperative corn tests, D. O. NOURSE (*Virginia Sta. Bul. No. 16, May, 1892, pp. 11*).—This is a brief report on experiments outlined by the late H. M. Magruder and carried out by thirteen farmers in different parts of the State. The details reported are incomplete and the results are inconclusive.

HORTICULTURE.

A. C. TRUE, *Editor.*

Methods of keeping sweet potatoes, J. F. DUGGAR (*South Carolina Sta. Bul. No. 5, July, 1892, pp. 8*).—Notes and tabulated data on an experiment in keeping small quantities of sweet potatoes in barrels containing various packing materials. Sweet potatoes of the Carolina Yam variety, dug October 26–28, in dry weather, were packed in lime barrels October 30 and 31 and examined January 15 and 16. The packing materials used were sand, cotton seed, cotton hulls, damaged lint cotton, wheat bran, newspapers, and hay. The best results were obtained with dry sand and cotton hulls. "Wrapping each potato with paper induced rapid decay," but "a double lining of paper next the barrel was fairly effective in keeping out cold and preventing rot. * * * In this test there was no great difference in the keeping qualities of large and small potatoes."

Analyses of fruit trees, P. COLLIER (*New York State Sta. Report for 1891, pp. 162–173*).—An investigation has been commenced at the station with the following varieties of nursery stock, to determine the kinds and amounts of mineral ingredients removed by them from the soil: 3 varieties of apples, 4 of cherries, 8 of peaches, 8 of pears, 4 of plums, 2 of crab apples, 2 of quinces, and 1 of grapes.

The trees were contributed for the purpose by several of the leading nurserymen of Geneva from their stock and were taken up early in the spring before the buds were well developed. The roots were as carefully cleaned of adhering earth as was possible, and after weighing the trees were allowed to become air-dry, when they were again weighed. Each tree was then divided into roots, trunk, and branches, which were separately weighed, and after cutting up were placed in glass jars to await analysis. Each sample was burned at a low red heat and the ash weighed and preserved for analysis.

The results are tabulated as far as secured and include the weight of parts and percentage of dry matter and ash for all of the varieties, and ash analyses of the branches, trunks, and roots of 3 varieties of apples, 4 of cherries, and 3 of pears. The calculated amounts of mineral ingredients removed by these trees from the soil are compared with those removed by different cereals.

The average weight of green trees was 924 grams. With rows 4 feet apart and trees 1 foot apart in the row, there would be on an acre 10,890 trees weighing 22,183 pounds or 11 tons. The average of the 31 trees gives 1.81 per cent of ash in the green tree, therefore there would be 399.3 pounds of ash removed by an average acre of nursery stock.

Quantitative analyses have been made of the ash of 3 apple trees, 4 cherry trees, and 3 pear trees, and the average of these 10, which do not widely differ in composition, shows that upon an average there is taken from the soil in 11 tons of nursery stock the following mineral constituents, each having been determined, except the carbonic acid of the ash.

Pounds of mineral matter removed by 11 tons of nursery stock.

	Pounds.
Silicic acid	50.6
Phosphoric acid	21.4
Sulphuric acid	14.3
Chlorine	1.3
Carbonic acid	94.9
Ferric oxide	6.1
Lime	138.6
Magnesia	23.7
Soda	21.3
Potash	27.1
Total	399.3

It is proposed to compare the ash analyses and to make analyses of the fruit of each variety another season.

Experiments with small fruits and vegetables, 1891 (*New York State Sta. Report for 1891, pp. 156–490*).—A report on tests of varieties and experiments with fertilizers and with fungicides.

Small fruits (pp. 458–474).—A reprint of Bulletin No. 36 (new series) of the station (E. S. R., vol. III, p. 313).

Vegetables.—Descriptive notes and tabulated data for 13 varieties of beans, 11 of onions, 16 of peas, and 15 of tomatoes. Brief accounts are also given of experiments with fertilizers on beans and onions. Nitrate of soda on onions produced a rank growth of tops, but did not increase the merchantable yield of bulbs.

Tests of varieties of orchard fruits and grapes, 1891, G. W. CHURCHILL (*New York State Sta. Report for 1891, pp. 491–498*).—Brief accounts of experiments in progress with apples, peaches, plums, and apricots, and descriptive notes on 48 of the newer varieties of grapes.

Horticultural work at Rhode Island Station, L. F. KINNEY (*Rhode Island Sta. Report for 1891, pp. 87, 88*).—A brief outline report on work in horticulture at the station in 1891.

ENTOMOLOGY.

Wheat insects, E. W. DORAN (*Maryland Sta. Bul. No. 16, March, 1892, pp. 437–449, figs. 6*).—Accounts are given of the Angoumois grain moth (*Gelechia cerealella*), red grain beetle (*Silvanus cassiæ*), lesser grain beetle (*Silvanus surinamensis*), and black weevil (*Calandra oryzæ*), with suggestions regarding remedies. Experiments by the author in heating grain infested with the Angoumois grain moth to temperatures of from 120° to 160° F. for periods of from two and one half minutes to two hours, gave negative results. The fumes of bisulphide of carbon and of naphthaline were successfully used for the repression of this insect. In a bin of wheat middlings infested with the red grain beetle it was found that where these insects were most numerous the

temperature of the middlings was materially increased, a phenomenon observed in three other recorded instances referred to in this article.

Insects injurious to the cabbage, H. E. WEED (*Mississippi Sta. Bul. No. 21, June 1892, p. 16, figs. 18*).—Illustrated descriptions of the following insects, with accounts of their natural enemies and suggestions as to remedies: Imported cabbage worm (*Pieris rapæ*), Southern cabbage butterfly (*Pieris protodice*), large cabbage butterfly (*Pieris monuste,*) cabbage plusia (*Plusia brassicæ*), zebra cabbage worm (*Mamestra picta*), cabbage evergestis (*Evergestis rimosalis*), cabbage plutella (*Plutella cruciferarum*), cutworms, cabbage aphis (*Aphis brassicæ*), harlequin cabbage bug (*Murgantia histrionica*), cabbage maggot (*Anthomyia brassicæ*), and many-striped flea beetle (*Phyllotreta vittata*).

Woolly aphis of the apple, F. H. HILLMAN (*Nevada Sta. Bul. No. 17, July, 1892, pp. 8, figs. 8*).—A popular account of the woolly aphis of the apple (*Schizoneura lanigera*), and of its insect enemies, with suggestions regarding remedies.

Wireworms, J. O'B. SCOBEY (*Washington Sta. Bul. No. 4, May, 1892, pp. 75–80, figs. 3*).—A popular account of *Melanotus communis* and *Agrotis mancus*, which infested wheat fields in Garfield County, Washington, in the spring of 1892.

Apicultural division of Rhode Island Station, S. CUSHMAN (*Rhode Island Sta. Report for 1891, p. 94*).—A brief report of the work of this division.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor*.

Cattle-feeding, W. H. NEWMAN (*Alabama Canebrake Sta. Bul. No. 15, July, 1892, pp. 7*).

Synopsis.—A comparison of fattening two steers and two old work oxen on cotton seed, cotton-seed meal, hulls, and hay. The oxen were fed at a financial loss, but there was a profit with the steers.

A trial is reported which was made to compare the financial results of fattening steers and turned-off oxen. The animals used consisted of two work oxen, about eighteen years old, and in poor condition, which were bought at 1.5 cents per pound; and two steers, about two and one half years old, in fair condition, bought at 2 cents per pound. These animals were fed in four periods of three weeks each from February 23 to May 17. The rations fed consisted of cotton-seed meal and cotton hulls, to which cotton seed and hay were added in one period. The amounts of food eaten and the fluctuations in the live weight of the animals are tabulated. The hulls were valued at \$5, the hay at \$10, and the cotten-seed meal at \$20.90 per ton, and the cotton seed at 20 cents per bushel. The two oxen gained 202 pounds and the two steers 476 pounds during the trial. The former were valued at $1\frac{3}{4}$ cents per pound and the latter at 3 cents per pound. On this basis there was a

loss of $8.08 in feeding the oxen and a profit of $11.36 in fattening the steers. No account is made of the labor in feeding or the value of the manure obtained.

Investigations of the several breeds of dairy cattle, P. COLLIER (*New York State Sta. Report for 1891, pp. 28–162, figs. 4*).—This is a summary of an investigation with Holstein, Ayrshire, Jersey, American Holderness, Guernsey, and Devon breeds of cows, which has been in progress at the station since April, 1889. Previous accounts of the progress of this investigation will be found in Bulletins Nos. 18, 21, and 34, and the Annual Report of the station for 1890 (E. S. R., vol. I, p. 269; II, p. 243; III, pp. 311, 401). Over 100 pages of tabulated data are given, including statements of the food and food ingredients eaten by each cow, both total amounts and amounts each month of lactation; analyses of the feeding stuffs used; yield of milk and of solids, fat, casein, milk sugar, and ash in each month of lactation, both percentage and total amounts; the average figures for each breed of cows, illustrated by diagrams; cost of rations; the relation of yield and composition of milk to certain food constituents; yield and composition of morning's and night's milkings; results of microscopic examination of milk of different breeds and from fractional milkings; and the average composition of milk of the different breeds studied.

The observations on the secretion of milk extend through one period of lactation in the case of every animal, observations in the earlier part of the investigation having been confined to the food consumed, fluctuations in live weight, etc.

There were fifteen cows, four Ayrshires, two Guernseys, two Devons, three Jerseys, two American Holdernesses, and two Holsteins, all in their first period of lactation. The food of the animals consisted of hay, with either corn silage, roots, or green fodder (corn fodder, red clover, vetch and oats, oats and peas, alfalfa, and sorghum), and various grain mixtures. The following remarks are based on summaries of the data given:

A table showing the relative cost of milk and butter production in the case of individual cows and of breed averages makes it evident that while there are some exceptional cases within breeds, "as a rule the Guernseys and Jerseys are noticeable for their low cost in butter production, while the Holstein-Friesians, Ayrshires, and Guernseys are characterized by their relatively low cost of milk production. The Devons and American Holdernesses stand more nearly midway between these other breeds. The dairyman needs, therefore, to select the breed best suited to his purpose, and also to thoroughly test the relative value of the individuals in his herd, of whatever breed or grade. These two points may be regarded as of prime importance."

Relation of food constituents to milk constituents (pp. 112–120).—Regarding the relation between certain constituents in the food eaten and in the milk produced, it is shown from a summary for all the cows, in most cases during the entire period of lactation—

That 27.5 per cent of the albuminoids of the food were utilized in milk production, while in a previous experiment with five cows it was found that the casein of the milk produced by them was equal to 26.5 per cent of the albuminoids present in the food consumed by them.

The excess of albuminoids consumed over and above the casein found in the milk was almost exactly double (198 per cent) the amount of fat produced in the milk; also the crude fat (ether extract) present in the food was 17 per cent greater than the fat present in the milk.

It is obviously of very great practical importance to determine if possible the source of the fat present in the milk, and the data already presented are valuable as throwing some light upon this as yet unsettled problem.

Dr. Foster, the eminent physiologist of Cambridge, England, in the latest edition of his Physiology, says, on page 785, that "the quantity of fat present in milk is largely and directly increased by proteid, but not increased—on the contrary diminished—by fatty food;" and he quotes approvingly that "Liebig showed that the butter (fat?) present in the milk of a cow was much greater than could be accounted for by the scanty fat present in the grass or other fodder she consumed."

Now we have shown that the average of thirteen cows gave a consumption of 62.3 pounds of albuminoids and of 26.4 pounds of crude fat, with a production in the milk of 19.6 pounds of fat, during the month of August; while in September they consumed upon an average 78.9 pounds of albuminoids and 22.3 pounds of crude fat, with a production of but 17.3 pounds of milk fat; or a decrease of 15.5 per cent in the fats consumed resulted in a decreased production of milk fat amounting to 11.7 per cent—results diametrically opposed at every point to the statement of Dr. Foster above quoted. And again, in July, the albuminoids fed were somewhat less than in June (6.3 per cent), while the amount of fat in the food was 14.9 per cent less in July than in June; but the decrease of albuminoids did not decrease the production of fat in the milk, nor did the decrease of fat in the food increase the fat in the milk, since in July it was within 0.5 per cent of what it was in June.

An interesting observation was made on the effect of food on the yield and composition of milk in the case of cows well advanced in milk. By November, 1890, all but seven of the cows had gone dry or were so nearly dry that they were withdrawn. The remaining seven were continued during November and December, all being in the last stages of the milking period. In the month of December the amount of silage fed was increased 50 per cent, the hay diminished a third, and cotton-seed meal substituted for corn meal, thereby increasing the albuminoids in the food 7.6 per cent and the crude fat 8.4 per cent over the amounts fed in November. The nutritive ratio for the month of November was 1:5.8 and for December 1:5.2. The results follow:

Summary for November and December.

	Months of period of lactation.	Albuminoids in food.		Fat in food.		Milk yield.		Percentage of fat in milk.		Amount of fat in milk.	
		Nov.	Dec.	Nov.	Dec.	Nov.	Dec.	Nov.	Dec.	Nov.	Dec.
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Per ct.*	*Per ct.*	*Lbs.*	*Lbs.*
Holstein ...	17th and 18th.	85.3	92.9	27.1	29.8	563.8	540.3	3.11	2.80	17.5	15.1
Ayrshire...	10th and 11th.	62.6	64.4	19.3	20.6	410.1	434.9	2.91	2.93	11.9	12.7
Jersey	15th and 16th.	52.9	58.6	17.1	19.0	155.9	164.3	5.87	6.45	9.2	10.6
Jersey	15th and 16th.	66.3	71.9	21.2	23.1	340.7	361.9	6.16	6.27	21.0	22.7
Guernsey ..	12th and 13th.	69.1	75.1	22.1	24.1	495.5	538.4	5.24	5.21	26.0	28.1
Devon......	9th and 10th.	62.3	65.3	20.1	21.1	311.9	328.8	5.31	4.66	16.6	15.3
Devon......	7th and 8th.	46.6	49.0	15.1	16.1	243.2	291.7	6.31	5.51	15.4	16.1

It will be seen that the change of food in December kept up the yield of milk at a time when it might be expected to be falling off, and at the same time increased the percentage of fat in the majority of cases, so that in every instance except two there was an absolute increase in the amount of fat secreted while on the richer ration.

Regularity of milk secretion (pp. 121–123).

During four days two Holsteins, three Jerseys, two Ayrshires, one Guernsey, and one American Holderness were milked regularly at intervals of twelve hours each, or as near that as was practicable, the exact time in each case being recorded. There were slight differences in the yield per hour, but not uniform for either animal, and the average results from these nine cows of five different breeds showed that the amount by weight of milk secreted from 5 p. m. to 5 a. m. was the same as that secreted from 5 a. m. to 5 p. m. during these four days of trial.

The average amount of milk secreted per hour was 0.696 pound during night and 0.7 pound during the day. The average composition of the morning's and night's milk found in four hundred and sixty-five analyses of each was as follows:

Percentage composition of morning's and evening's milk.

	Morning's milk.	Evening's milk.
Water	86 25	86.39
Total solids	13.75	13.61
Fat	4.26	4.22
Solids-not-fat	9.49	9 35
Casein	3.61	3.55
Milk sugar	5.14	5.11
Ash	0.737	0.719
Nitrogen	0.57	0.561

Source of fat in milk (pp. 124–129).—Bearing upon this question, the amounts of crude fat in the food eaten and of butter fat in the milk produced have been compiled for each of the fifteen cows on trial and for each month of lactation.

The aggregate number of pounds of crude fat consumed by these animals was 4,587.9, and the aggregate amount of milk fat produced by them was 3,793.4 pounds, or as 121 to 100. If we allow upon an average 17.4 per cent of the crude fat as impurity, it would still leave fat enough in the food to account for all recovered in the milk. * * * During the earlier months the production of fat in milk is considerably in excess of even the crude fat of the food, but very soon the amount of crude fat eaten and the amount produced become equal, and by a rather steady increase relatively the amount of crude fat consumed becomes at later months of lactation largely in excess of the fat produced in the milk.

It would appear, therefore, that whether or not the fat of the milk is wholly or in part obtained from the fat in the food, there is little if any room for doubt that ordinarily the food contains enough fat to equal that produced in the milk.

Fractional milking (pp. 129–139).—To observe the percentage of fat and the relative number and size of fat globules in milk from the first and last portions of milking, the first and last pints milked from an American Holderness cow at three different dates and the first and last

halves of the milkings from a Guernsey, two Ayrshires, and another cow at a single milking were taken for examination, together with the mixed milk from the whole milking in each case. The results of these observations are tabulated. The first pint milked contained only one third of a per cent of fat, while the last pint contained 6.85, and the mixed milk from the whole milking averaged 2.55 per cent. The same was true in case of the first half of the milking of five cows. "In every instance the first half contained only one third to one half the fat present in the last half. The average for the five cows was 4.21 per cent of fat in the normal milk, 2.52 per cent in the first half, and 5.89 per cent in the last half." Corresponding with the higher percentage of fat, both the total number of globules and the number of large globules were greater in the last half.

In another trial the milk of five cows was milked in successive pints, each pint being drawn from the four teats in approximately equal quantities.

By the aid of an assistant the operation of milking was not prolonged over two or three minutes and was without any apparent annoyance to the cow.

The successive pints were analyzed, and after the samples were taken for analysis the remainders were mixed thoroughly, after which a sample was also taken for analysis.

The most striking points brought out in these experiments are as follows:

(1) The steady increase in the number of fat globules in a definite volume of milk (0.0001 c. mm.), also in the average and relative size of these globules.

(2) The increase in the number of the larger globules in the later pints of milk drawn, and as a result

(3) The steady increase in the percentage of fat in the successive portions of milk.

* * * The secretion of milk, as we have already shown, is a regular and continuous process, the amount of milk capable of being drawn from the udder being exactly proportional to the length of time allowed for its secretion. It would appear that the phenomena which are shown by the examination of these fractional milkings were due merely to what by comparison we may term "warm setting" within the udder and other milk vessels of the animal.

The inference from a single test was that "the differences in the successive portions of milk drawn were almost wholly in the relative amount of fat they contained."

Activity of the physiological processes (p. 155).—"We have seen that several cows under experiment secreted night and day an average of 0.7 of a pound of milk each hour, or nearly 19.6 cubic inches of milk. As an average of over one hundred and fifty determinations with the milk of the fifteen animals of the six breeds, we learn that there were in $\frac{1}{10000}$ of a millimeter of milk an average of one hundred and fifty-two fat globules, and a little calculation will show that by each of these animals there were secreted each second an average of nearly 136,000,000 globules of fat." Further studies on the character of the milk itself are given on p. 268.

Feeding for milk and butter, E. R. LLOYD (*Mississippi Sta. Bul. No. 21, June, 1892, pp. 20–24*).

Synopsis.—A comparison on six lots of five cows each of timothy hay with Bermuda hay, and of cotton-seed meal with raw and steamed cotton seed. At the prices current and with the cows used Bermuda hay and steamed cotton seed were the cheapest food for milk and butter production.

An experiment is reported with thirty cows, in continuation of previous trials at this station with different feeding stuffs reported in Bulletins Nos. 13 and 15 of the station (E. S. R., vol. II, p. 362, and III, p. 166). The cows were divided into six lots of five each, one cow in each lot being a grade Holstein and the remainder grade Jerseys. As nearly as possible, the cows in each lot averaged the same time from calving. These lots were fed during five weeks on rations consisting of silage, Bermuda or timothy hay, and cotton-seed meal or raw or steamed cotton seed, the rations for each lot remaining unchanged throughout the trial. The milk from each milking was weighed and tested for butter fat. From these results the amount of butter was calculated by a formula not given. The yields of milk, the calculated yields of butter, and the cost of food are summarized for each lot. The milk yield of the several lots previous to the experiment are not given, so that it becomes impossible to determine whether the differences in yield were due entirely to the differences in the food or to natural difference in the milking capacity of the cows in the different lots. The author assumes the former to be true, and concludes that the best results were obtained from lot 3, receiving Bermuda hay, silage, and steamed cotton seed. This lot gave the largest yield of milk and butter, producing milk at a cost of 4.9 cents per gallon and butter at 10 cents per pound. "Ton for ton, the two hays have practically the same milk and butter-producing values." He remarks further that the butter from cows fed on steamed cotton seed was "much superior to that of either of the other lots."

From the work accomplished during the past three years it appears that—

(1) Equal weights of Bermuda and of timothy hay have practically the same values for the production of milk or butter.

(2) At the prices at which they can be purchased in Mississippi, Bermuda hay will produce milk or butter at a much less cost than will timothy hay.

(3) The milk and butter from cows fed on steamed cotton seed cost less than that from cows fed on raw cotton seed, and but little more than one half as much as that from cows fed on cotton-seed meal.

(4) The butter from steamed seed is superior in quality to that from either raw seed or from cotton-seed meal.

Influence of food upon the fat in milk, WALTER J. QUICK (*Colorado Sta. Bul. No. 20, August, 1892, pp. 11–20*).

Synopsis.—The result of two experiments are tabulated, which were made to compare ground oats with wheat bran, and to compare linseed meal, corn meal, and wheat bran.

Ground oats vs. wheat bran (pp. 12–16).—Four cows, two Shorthorns and two Jerseys, were fed for a period of ten days on a ration of 6 pounds

per day of ground oats and alfalfa hay *ad libitum*; at the end of that time wheat bran was substituted for oats, and the feeding continued ten days longer. The cattle were weighed daily and samples of milk were taken from each milking for testing by the Babcock method. The average percentage of fat in each period and the gain or loss in live weight are tabulated for each animal. The yield of milk is not given. Owing to the peculiar method of sampling there were wide discrepancies between the results of the Babcock test and the gravimetric analyses. The average composition of the milk, as shown by the Babcock test, was slightly higher in the second period when bran was fed. Three of the cows fell off in milk yield in the second period.

Comparison of linseed meal, corn meal, and wheat bran (pp. 16–20).—In eight periods of ten days each these feeding stuffs were compared on six cows, feeding them in various combinations with each other and with alfalfa hay and oat straw. Daily tests were made of the milk, and the results of these, together with the yield of milk and the fluctuations in live weight, are tabulated for each cow without comment.

Feeding grain to lambs, J. A. CRAIG (*Wisconsin Sta. Bul. No. 32, July, 1892, pp. 3–8 and 11–15, plate 1*).

Synopsis.—A comparison of feeding grain to unweaned lambs, to ewes, and to both lambs and ewes, and of feeding no grain. The trial was with four lots of ten ewes and fourteen lambs each, and lasted for ten weeks. The best result, as shown by the gain in weight of the lambs, was from feeding the grain to the lambs, and in no instance was there any apparent benefit to the lambs from feeding grain to their dams. The lambs fed grain were valued at ¾ of a cent per pound higher than those receiving no grain.

The object of this trial was to compare the results on the unweaned lambs of feeding grain to the lambs, to the ewes, and to both ewes and lambs, and of feeding no grain. Four lots of ten ewes and fourteen lambs each, as nearly equal as possible in every respect, were fed for ten weeks as follows: Lot 1, grain mixture to both lambs and ewes; lot 2, grain mixture to lambs alone; lot 3, grain mixture to ewes alone; lot 4, no grain.

The grain mixture was the same for all the lots and for both ewes and lambs. During the first three weeks it consisted of one part of oil meal and three parts of bran, and later of one part of crushed corn, one part of oil meal, and two parts of bran. The lambs receiving grain were given all they would eat. All of the ewes received hay of a poor quality at first and later good pasturage. The ewes fed grain received 1 pound per day while on hay and one half pound while on pasturage. The gain in weight of the lambs and the cost of the food consumed by each lot, exclusive of pasturage (the same for all), was as follows:

Gain of lambs and cost of feed.

	Grain fed.	Gain of lambs.	Cost of feed.*
		Pounds.	
Lot 1	Grain to both lambs and ewes	432	$8.59
Lot 2	Grain to lambs alone	450½	5.15
Lot 3	Grain to ewes alone	385¾	6.05
Lot 4	No grain	395¾	2.10

* Exclusive of pasturage.

Regarding the effects of feeding grain to the lambs, it will be seen by comparison of lots 2 and 4 that the lambs in lot 2, receiving grain, gained 54¾ pounds more than those in lot 4, without grain, the difference in cost of feed of the two lots being $3.05; "that is, the lambs that were fed all the grain they would eat made a pound of gain at a comparative cost of 5½ cents per pound, or at the rate of $5.50 per 100 pounds gain. This is well within the market value of lamb at this time, for lambs were quoted from $6 to $7 per 100 pounds in Chicago market, and these grain-fed lambs were of the best quality." In the opinion of a local buyer the lambs fed grain were worth three fourths of a cent per pound more than those of lot 4, receiving no grain. This gives a difference in value of $9.05 in favor of lot 2 at an increased cost of $3.05 as compared with lot 4.

"It is self-evident that it paid to feed the lambs all the grain they would eat. The lambs that have previously received grain will not lose in weight because of the weaning. As a result of the grain-feeding they have gradually become able to feed themselves, and when the weaning period arrives they do not fret or require the assistance of their dams to keep gaining in weight."

In no instance was there any apparent benefit to the lambs from feeding grain to their dams. The lambs in lot 4, without grain, gained 10 pounds more than those in lot 3, where grain was fed to the ewes. The lambs in the lot in which the ewes were fed grain did not gain as much as the lambs in the lot in which the ewes did not receive grain, although the ewes receiving grain did not lose as much flesh as those without grain. This difference, however, is believed to be of little practical value. The author's conclusions are as follows:

(1) It pays to feed the lambs before they are weaned all the grain they will eat when on good blue grass or clover pasture with their dams. This conclusion is endorsed by a previous trial.

(2) When the ewes have been properly fed during the winter, so as to be in good condition at lambing time, it does not pay to feed them grain when on good pasture with the object of securing more rapid and profitable gains in the lambs.

An illustrated description is given of a lamb creep.

Cotton-seed meal compared with oil meal for feeding lambs, J. A. Craig (*Wisconsin Sta. Bul. No. 32, July, 1892, pp. 9, 10, and 16*).

Synopsis.—A comparison of linseed meal and cotton-seed meal for lambs about three months old. Two lots of five lambs each were fed cotton-seed meal and linseed meal, respectively, in addition to corn meal and pasturage for ten weeks. The lot fed linseed meal made the larger gain, and at the prices quoted the cheaper gain.

To compare the effect of feeding linseed meal and cotton-seed meal to young lambs, two lots of five lambs each, Shropshire grades of good quality and about three months old, were used. Both lots were pastured in the same pasture, and from July 16 to September 24, ten weeks, received all they would eat of the following grain mixtures: Lot 1, one part by weight of linseed meal and two parts of corn meal, and lot 2, one part of cotton-seed meal and two parts of corn meal. During the experiment one of the lambs in lot 2 died. The average weekly gain per lamb was 3.3 pounds for the lot receiving linseed meal, and 2.95 pounds for the lot receiving cotton-seed meal. Valuing corn meal at $14, linseed meal at $20, and cotton-seed meal at $25 per ton, the cost of feed per pound of gain in live weight was 2 cents for the linseed-meal lot and 3⅓ cents for the cotton-seed meal lot.

The results of this trial show:

(1) For feeding lambs, a grain mixture of oil meal and corn meal gave better results than a grain mixture of cotton-seed meal and corn meal.

(2) The lambs fed the oil meal made a greater gain than those receiving the cotton-seed mixture. During the ten weeks' trial the lambs fed the oil meal ration each made a weekly gain of 3.3 pounds, while those getting the cotton-seed ration each made a weekly gain of 2.95 pounds.

(3) The oil-meal ration was in addition cheaper; for the lambs so fed made 100 pounds gain at a cost of $2, or 2 cents per pound, while those getting the cotton-seed ration made 100 pounds gain at a cost of $3.30, or 3⅓ cents per pound.

Swine-feeding, W. P. WHEELER (*New York State Sta. Report for 1891, pp. 202–207*).—The experiments reported are in continuation of those in feeding prickly comfrey, clover, sorghum, mangel-wurzels, etc., to pigs, described in Bulletin 28 of the station (E. S. R., vol. II, p. 735). The data are tabulated, with few details.

While the results have generally favored the addition of salt to the ration when only a small proportion of the coarser foods was used, they have not tended always in the same direction when a large proportion was fed. While feeding clover, corn silage, sorghum, etc., better results have generally attended the ration to which salt has been added, but whenever mangel-wurzels have been fed the pigs having salt have generally made much poorer gains. This may perhaps be due to the fact that as a much larger amount of salt exists in mangel-wurzel than in most other foods the salt added is enough to make an injurious quantity.

Poultry experiments, W. P. WHEELER (*New York State Sta. Report for 1891, pp. 182–202*).—This is a reprint of the articles on oyster shells, tallow, and salt for hens, and skim milk for growing chickens, published in bulletins Nos. 38 and 39 of the station (E. S. R., vol. III, pp. 705, 709).

Poultry division of Rhode Island Station, S. CUSHMAN (*Rhode Island Sta. Report for 1891, pp. 89–93, plate 1*).—This article contains a description of the buildings and outfit of the poultry division, which was established the past year, and on account of visits to poultry-raising establishments in New Jersey, Long Island, and New England.

Much of this season's work has been to prepare for our principal experiment of next season, which will be to make a variety of first crosses for the production of

the best market roasters and capons, their value as broilers and for egg production being a secondary consideration. We have procured for this purpose 12 varieties of pure-bred fowls and have mated them with this end in view. Besides these birds we have one pair and one trio of imported Embden geese, nine fine Pekin ducks, two Pekin drakes, and one pen of pure Light Brahma fowls. A few turkeys are soon to be added to the stock.

Visitors having a special interest in this line of work have been quite numerous and there evidently is a wide field of usefulness for such a division.

VETERINARY SCIENCE AND PRACTICE.

Veterinary division of Rhode Island Station, F. E. RICE (*Rhode Island Sta. Report for 1891, pp. 95–97*).—Brief mention is made of a disease known as "the gaunts," affecting bovine animals, a disease among turkeys, and of experiments to be made on tuberculosis.

DAIRYING.

E. W. ALLEN, *Editor.*

Studies of the milk of different breeds of cows, P. COLLIER (*New York State Sta. Report for 1891, pp. 139–162, fig. 1*).

Synopsis.—These studies were made in connection with the investigation of Ayrshire, Jersey, American Holderness, Guernsey, Devon, and Holstein breeds of dairy cows reported above (p. 255). There were fifteen cows in all and the observations extended over one (the first) period of lactation in each case. The subjects receiving especial attention were, composition of the milk and microscopic examinations of milk, effect of size of globules upon creaming, and changes in milk globules during lactation.

Composition of milk (pp. 139–142).—The average daily yield of milk and the composition of the milk are given for each of the breeds under investigation as follows, the table representing an aggregate of nine hundred and thirty analyses:

Average composition of milk of different breeds.

Breed.	Number of analyses.	Water.	Total solids.	Solids-not-fat.	Fat.	Casein.	Milk sugar.	Ash.	Nitrogen.	Daily milk yield.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Lbs.*
Holstein-Friesian	132	87.62	12.39	9.07	3.46	3.39	4.84	0.735	0.540	22.65
Ayrshire	252	86.95	13.06	9.35	3.57	3.43	5.33	0.698	0.543	18.40
Jersey	238	84.60	15.40	9.80	5.61	3.91	5.15	0.743	0.618	14.07
American Holderness	124	87.37	12.63	9.08	3.55	3.39	5.01	0.698	0.535	13.40
Guernsey	112	85.39	14.60	9.47	5.12	3.61	5.11	0.753	0.570	16.00
Devon	72	86.26	13.77	9.60	4.15	3.76	5.07	0.760	0.595	12.65
Average	....	86.37	13.64	9.40	4.24	3.58	5.09	0.731	0.534	16.20

"According to the above table the ash varies least among the above constituents of milk, sugar next, then casein, and fat, by far in excess of all, varying over four times as much as casein. This fact would clearly demonstrate that the per cent of fat present is the most reliable

test by which to determine the relative value of normal milk, not only for butter production, but also for the manufacture of cheese."

Following is the average percentage composition of the total solids in the milk of different breeds as found in the present investigation:

Average composition of total solids of milk.

Breed.	Total solids	Solids-not-fat.	Fat.	Casein.	Sugar.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Holstein-Friesian	100	73 2	28. 0	27. 4	39 1	5. 93
Ayrshire	100	71. 6	27. 3	26 3	40. 8	5. 34
Jersey	100	63. 6	36. 4	25. 4	33. 4	4. 82
American Holderness	100	71. 9	28. 1	26. 8	39. 7	5. 53
Guernsey	100	64. 9	35. 1	24. 7	35. 0	5. 16
Devon	100	69 7	30 1	27. 3	36. 8	5. 52
Average	100	69. 2	30. 8	26. 3	37. 5	5. 38

As will be seen, the casein varies from 24.7 to 27.4 or 10.9 per cent, the sugar from 33.4 to 40.8 or 22.2 per cent, the ash from 4.82 to 5.92 or 23 per cent, and the fat from 27.3 to 36.4 or 33.3 per cent, or very appreciably more than either of the other constituents of the total solids.

It is to be remembered that these results may differ as the animals become more mature and can only be urged as true for the first period of lactation; but the results thus far secured conclusively establish the fact that despite the great differences which we find in the individuals even of the same breed, there are marked differences which characterize the milk from the different breeds.

Microscopic examinations of milk (pp. 143–155).—A large number of interesting data are given on this subject.

It comprises the results of an actual count and measurement of 44,836 globules from the milk of fifteen cows of the six breeds under investigation. There were in all four hundred and fifty-four examinations, with an average of ninety-nine globules measured and counted at each examination, and averaging thirty examinations for each cow. [The data presented confirm the observation that] as the period of lactation advances the relative number of the smaller globules increases with considerable regularity, and especially is this the case up to the twelfth month of lactation, after which the number of animals for comparison dropped off. In contrast to this the relative number of the larger globules steadily diminishes as lactation advances. * * *

A remarkable resemblance [is noticeable] between the milk from the Holstein-Friesians and the Ayrshires upon the one hand, and between the Jerseys and Guernseys upon the other, while the American Holdernesses and Devons appear to occupy a midway position.

The large number of small globules and relatively small number of the larger globules of the Holstein-Friesians and Ayrshires, as contrasted with the opposite character of the Jersey and Guernsey milks, is very remarkable.

The proportion of the fat globules found to be over three divisions of the micrometer* in diameter was about 70 per cent in the Jersey milk, over 55 in the Guernsey milk, about 35 in the Devon and American Holderness milk, 24 in the Ayrshire milk, and only 11.3 in the Holstein milk. It was further found that the globules over three divisions in

*One division of micrometer scale $\frac{1}{10571}$ inch.

diameter contained 62.5 per cent of the total amount of fat in the Jersey milk, 55.4 per cent in the Guernsey, 34.4 per cent in the Devon, 34.9 per cent in the American Holderness, 24.1 per cent in the Ayrshire, and 11.3 per cent in the Holstein. The following table shows more clearly the percentage of the total fat present in the different-sized globules in the case of different breeds of cows:

Per cent of total fat in different-sized globules.

	Less than one division.	One to two divisions	Two to three divisions.	Three to four divisions.	Four to five divisions.	Five to six divisions.
Jerseys	0.1	11 3	26.1	30.7	23.9	7.9
Guernseys	0 1	11.3	33.2	29.7	25.7	....
Devons	0 1	23.0	42.5	34.4	....	....
American Holdernesses	0.3	24.7	40 1	27.6	7 3	....
Ayrshires	0.3	34.0	41.6	17.8	6.3	....
Holstein-Friesians	0.3	38.3	50.1	11.3	....	....
Average	0.2	23.8	38.9	25.3	10 5	1.3

"These characteristic differences are of prime importance in explaining the deportment of these milks in the operations of butter or cheese-making."

Effect of size of globules upon creaming (pp. 155–159).—It is calculated that in raising cream in submerged cans 18 inches deep and skimming after twelve hours—

Upon an average the fat globules in the lower strata of milk must rise about 1¼ inches per hour, but owing to the minuteness of these globules their apparently slow progress is indeed relatively very rapid, since it requires the smaller globules, represented as less in diameter than one division of the micrometer scale, to move each second over a space two hundred times greater than the diameter of the globules.

Should we suppose a balloon 25 feet in diameter to rise with equal relative velocity, it would rise about 1 mile per second. * * *

Now, since the resistance which these globules meet with in rising increases with the square of their diameter, while their ascensional force or buoyancy increases as their volumes or as the cubes of their diameters, we may readily conclude that the larger globules are those first to reach the surface, and that if any fail to do so, it must be the smaller globules, which the microscope should show in the skim milk. * * *

On December 29, 1891, an American Holderness cow, one month in milk, gave milk which by the Cooley system of setting and by the Baby separator yielded skim milk of the following composition as determined by microscopic examination and the Babcock test of the fat. The composition of the whole milk is also given for comparison.

Size and number of fat globules in whole and skim milk.

	Less than one division.	One to two divisions.	Two to three divisions.	Three to four divisions.	Average size.	Average size in inches.	Number in 0 0001 c. mm.	Per cent of fat.
Skim milk, Cooley system	18	12	2	....	84	$\frac{1}{18445}$	40	0.1
Separator skim milk, Baby separator	28	19	....	....	72	$\frac{1}{20964}$	72	0.1
Whole milk	28	52	11	5	116	$\frac{1}{13357}$	105	2.55

Even if some of the globules below one division were recovered in the cream—a most unwarrantable supposition—there were recovered nearly two thirds (64 per cent) of those globules between one and two divisions in diameter, and practically all of those larger.

It will also be observed that while there was upon an average half as many fat globules in the skim milk as in an equal volume of normal milk, the skim milk contained only 4 per cent as much total fat as was present in the full milk.

These results are entirely in accord with the facts set forth in the table giving the "per cent of total fats in the different-sized globules."

Illustrative of the difference which the milk of different breeds may exhibit in rapidity of creaming, a trial is reported in which a single sample each of Jersey and Ayrshire milk was set 11 inches deep in 500 c. c. cylinders at 6:45 a. m., and small portions taken for analysis from the bottom of the cylinder at frequent intervals without disturbing the milk. The results follow:

Fat content of Jersey and Ayrshire milk.

Source of sample.	Time of sampling.	Jersey.		Ayrshire.	
		Amount of sample	Fat.	Amount of sample.	Fat.
		c. c.	*Per cent.*	*c. c.*	*Per cent.*
Bottom	8·00 a. m.	18	2.9	18	3.0
Bottom	11·00 a. m.	28	1.5	28	2.3
Bottom	11·30 a. m.	26	1.1	28	2.2
Bottom	10.00 p. m.	28	1.0	25	1.7
Middle	1:00 p. m.	26	6.4	27	3.5

The contrast is quite marked, and it will be seen that the Ayrshire milk, although [originally] containing far less fat, was, after six and a quarter hours setting, much richer in fat in its lower portion than was the Jersey milk. It will be seen also that after a fifth of the milk had been withdrawn the portion taken from the middle of the remaining 400 c. c. was richer in fat than the original milk, in both cases.

Changes in milk globules during lactation (pp. 160–162).—As is well known, with the advance of the milking period the yield of milk diminishes in quantity, the fat globules diminish in size, and the number of globules in a given quantity of milk increases. Now, to ascertain whether the actual number of fat globules secreted in the milk decreases or increases as lactation advances, calculations are made on the basis of the extensive microscopic studies mentioned above. Dividing the period of lactation of each cow into four parts, it is shown that on an average for the whole herd the relative number of globules secreted was 100 in the first quarter, 137 in the second quarter, 149 in the third quarter, and 189 in the fourth quarter; that is, the whole amount of milk given in the last quarter contained 89 per cent more fat globules than that given in the first quarter.

The changes in diameter and volume of fat globules during the first twelve months of lactation are shown in a table and a diagram. This makes it evident that in the first month nearly 61 per cent of the total fat was in the form of globules more than three divisions of the scale

in diameter; while in the twelfth month only 41 per cent was present in globules of this size, 59 per cent being in smaller globules. Again, in the first month only about 10 per cent of the fat was in globules less than two divisions in diameter, while in the twelfth month over 20 per cent was in globules under this size. Of the total number of globules in the first month, less than 80 per cent were under three divisions in diameter, and in the twelfth month fully 90 per cent. "It will be seen how very small a percentage of the fat is present in the globules less than one division in diameter, although the number of globules is pretty large."

A new method for determining the amount of butter fat in milk, L. G. PATTERSON (*Mississippi Sta. Bul. No. 21, June, 1892, pp. 17–19*).—The method described is essentially the Beimling method, with slight modifications. The Beimling centrifuge and test bottles are used, and the same amount of milk (15 c. c.) is taken, but 1½ c. c. of amyl alcohol is added instead of 3 c. c. of a mixture of amyl alcohol and hydrochloric acid, as used in the Beimling method. After whirling the bottles for one minute they are filled nearly to the top of the neck with hot water and again whirled for one half minute, after which the column of fat is read off. Other than slight changes in manipulation, the chief differences between this method and the Beimling are that the hydrochloric acid is omitted and that the bottles are whirled twice, adding hot water before the second whirling. The author gives the results of forty-eight comparisons of the "new method" with the Beimling method. The results by the new method are in some cases higher and in some cases lower than those by the Beimling method, the difference ranging from 0 to 0.18 per cent of fat and averaging 0.03 per cent. The principal advantages which the author claims for the new method over others are—

(1) A clear and sharply defined fat column, which is easily read by either day or lamplight.

(2) The accuracy of the results are not vitiated by the charring of the fat column.

(3) The contents of the bottles never foam over.

(4) It is the most rapid method we have found, six tests being made in duplicate in twenty-two minutes and one test in duplicate in four minutes.

(5) Cheapness, each test costing only about one fifth of a cent.

The best milk tester for the practical use of the farmer and dairyman, WALTER J. QUICK (*Colorado Sta. Bul. No. 20, August, 1892, pp. 3–10, figs. 3*).—The Babcock, Short, and Cochran methods are illustrated and described, and the results are tabulated of eight comparisons of the Babcock with the gravimetric method, and of fourteen comparisons of the Babcock, Short, and Cochran methods. As a result of the trial, the author believes the Babcock method to be "the best milk tester on the market for practical use." The De Laval Baby separator is highly spoken of.

Comparison of dairy breeds of cattle with reference to production of butter, L. L. VAN SLYKE (*New York State Sta. Report for 1891, pp. 299–369*).

Synopsis.—A study on the milk of Jersey, Guernsey, Holstein, Ayrshire, Devon, and American Holderness breeds during one period of lactation (ten months). The fat was recovered most completely in butter-making from the Guernsey milk, the Jersey closely following. The Jerseys gave the largest amount of butter per 100 pounds of milk. The Holsteins averaged the largest amount of milk per day, but the Guernseys, closely followed by the Jerseys, gave the largest daily yield of butter. The Guernsey cream churned quickest and the Holstein cream required the longest churning. The average cost of food per pound of butter ranged from 11.07 to 16.07 cents with the Guernseys and Jerseys and from 22.04 to 23.03 cents with the other breeds. The profits per cow during ten months were largest from the Guernseys and Jerseys and smallest from the Ayrshires and Devons. The Holstein and Holderness breeds were but slightly better than the two latter in this respect.

The data here given were obtained in connection with the test of different breeds of dairy cows mentioned above. It shows the record of one or more individuals of each of six breeds for the first ten months of the first period of lactation. This record shows the cost of food consumed and of butter produced; the fat lost and recovered in butter-making; relations of milk, cream, and butter; daily and monthly yields of milk and butter; temperature and time of churning; and the relative number and size of fat globules in the milk.

Cost of food consumed and of butter produced (pp. 302–305).—The cost of food is based on the following prices per ton:

Clover hay	$12.00
Mixed hay	10.00
Silage	3.00
Green fodder	2.00
Mangel-wurzels	3.00
Corn meal	20.00
Wheat bran	20.00
Ground oats	25.00
Linseed meal (old process)	26.50
Linseed meal (new process)	20.00
Gluten meal	27.00
Wheat middlings	20.00
Cotton-seed meal	29.60

"In calculating the cost of butter production the food alone is considered. The skim milk and buttermilk are worth something, but there is no recognized market value for these by-products, and it is considered best to leave them out of consideration and to calculate the cost of the butter without reference to them."

The average cost of food per pound of butter produced is given for each breed and each month of lactation, as follows:

Cost of food consumed for each pound of butter made.

Month of lactation.	Ayrshires.	Devons.	Guernseys.	Holdernesses.	Holsteins.	Jerseys.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1	14.24	15.00	9.57	8.63	....	9.96
2	16.14	17.69	11.79	20 00	21.65	14.73
3	22.18	20.42	15.42	25 69	19.55	19.96
4	23 38	20.00	16.59	23.81	26 74	17.64
5	26.77	23.61	15.45	24.56	23.87	16.61
6	24 41	23.31	16.94	24.65	21.05	18.74
7	26.84	29 83	16.41	24.93	21.22	18.18
8	28.50	23.20	15.36	26.00	21.60	18.36
9	27.00	24 08	13.66	25 30	20.36	17.85
10	27.43	25.17	17.21	19.83	33.00	17.75
Average	23.03	22 17	14.07	22.04	22.61	16.70

Allowing 25 cents per pound for butter and making no allowance for the manurial value of the food or the value of the skim milk and buttermilk, the profits for each breed during the ten months are given as follows, the calculation being made to one cow in each case:

Guernseys $27.60, Jerseys $22.15, Holsteins $5.75, Holdernesses $4.65, Devons $4.30, Ayrshires $3.70.

Fat lost and recovered in butter-making (pp. 305–310).—The loss of fat in butter-making is stated both in total amount per 100 pounds of milk and in per cent. The creaming appears to have been by some gravity process. Nothing is said as to the manner of churning, which was presumably the same for each breed. The absolute amounts of butter fat lost and recovered from 100 pounds of milk are calculated as follows:

Fat lost and recovered from 100 pounds of milk.

Breed.	Fat in fresh milk.	Fat recovered in butter.	Fat lost in— Skim milk.	Fat lost in— Buttermilk.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Jersey	5.68	5.06	0.37	0.06
Guernsey	5.02	4 57	0.32	0.03
Devon	4.46	3.67	0.57	0.03
Holstein	3.74	2.79	0.68	0.12
Holderness	3.60	3.01	0.44	0.05
Ayrshire	3.50	2.77	0.55	0.09

The difference between the amount of fat originally in the milk and that contained in the butter, skim milk, and buttermilk is probably due to mechanical loss in handling. The relative butter-making efficiency of the fat in milk of different breeds, as shown by the amount of butter made from 1 pound of fat in the milk, was:

	Pounds.
Guernseys	1.07
Jerseys	1.04
Holdernesses	0.98
Devons	0.97
Ayrshires	0.93
Holsteins	0.88

The milk fat of the Guernseys was recovered most completely in the butter. Since the greatest loss of milk fat in butter-making is in creaming, where gravity processes of creaming are employed, the proportion of milk fat recovered in the butter follows more or less closely the proportion of milk fat recovered in the cream. For every 100 pounds of milk fat recovered in the butter in the case of the Guernseys the other breeds recover the following amounts:

	Pounds.
Guernseys	100.0
Jerseys	98.0
Holdernesses	91.9
Devons	90.4
Ayrshires	86.9
Holsteins	82.0

Although the Guernsey milk creamed slightly more thoroughly than the Jersey milk, the latter contained more fat per 100 pounds of milk and stood first in the actual amount of butter made from 100 pounds of milk.

Relations of milk, cream, and butter (pp. 310-312).

It required less milk to make 1 pound of butter in the case of the Jerseys than in the case of any other breed. * * * If 100 pounds of Jersey milk makes a certain amount of butter, the arrangement below indicates how much milk of each breed will be required to make the same amount of butter:

	Pounds.
(1) Jerseys	100.0
(2) Guernseys	111.3
(3) Devons	140.0
(4) Holdernesses	170.8
(5) Ayrshires	183.3
(6) Holsteins	183.9

The cream made from the milk of the Jerseys contained most fat. In the case of the other breeds, the amount of fat in the milk seemed to have no definite relation to the amount of fat in the cream. This is a somewhat uncommon experience, it being generally held that by the same method of creaming the richness of the cream in fat will vary with the richness of the milk in fat. The Guernseys stand second in respect to amount of fat in milk, but their cream is least rich in fat. * * * The Holstein milk stands fourth in respect to the amount of its milk fat, while the cream stands second in richness of fat.

Daily and monthly yields of milk and dairy products (pp. 312–316).—The average daily yield of milk and butter during the ten months is stated as follows:

Average daily yield of milk and butter.

Breed.	Milk.	Butter.
	Pounds.	*Pound.*
Jersey	14.9	0.89
Guernsey	16.6	0.90
Devon	12.0	0.51
Holstein	24.3	0.79
Holderness	14.9	0.52
Ayrshire	18.6	0.61

The Holsteins gave the largest average amount of milk daily, while the Guernseys, closely followed by the Jerseys, gave the largest average daily yield of butter. * * * If the milk of the Holsteins did not lose so much fat in creaming, the Holsteins would easily make the largest amount of butter. The question arises as to the best method of getting the fat of the Holsteins from the milk to the butter without such serious loss. This can be accomplished satisfactorily by using a centrifugal machine for creaming the milk. As we propose to use a centrifugal separator in connection with the second period of lactation, the results will be brought out in our future work.

Temperature and time of churning (p. 316).—The Jersey milk was churned at the lowest temperature (62.3° F.) and the Devon milk at the highest temperature (66.6° F.). The time required for churning was shortest in the case of the Guernsey cream, thirty-one minutes, and longest in the case of the Holstein cream, ninety-one minutes. The time required was in the following order: Guernsey, Ayrshire, Devon, Jersey, Holderness, Holstein.

Fat globules of milk (pp. 316–318).—The relative number and size of fat globules in milk of different breeds is briefly given. A more detailed account of the studies of fat globules is given above (p. 263).

General summary of the results relating to butter production of different breeds (pp. 318–363).—The tables given present a summary of the more important average results and the records of the individual cows of each breed.

The influence of advancing lactation upon the production of butter, L. L. VAN SLYKE (*New York State Sta. Report for 1891, pp. 369–386*).—Tables are given showing the effect of advancing lactation upon the percentage of fat in the milk and upon creamability and churnability, the figures given being in each case averages for breeds. These tables bring out the following points:

(1) In most cases the per cent of fat in the milk is greatest during the first month of lactation. The Devons furnish an exception to this general statement, since the per cent of fat was least in the first month of lactation.

(2) In the second month of lactation the per cent of fat drops considerably in most cases, the diminution being greatest in the richer milks. In the milks containing the smaller proportions of fat, as the Ayrshires, Holdernesses, and Holsteins, the diminution of per cent of fat continued until the sixth or seventh month of lacta-

tion, while with the Guernseys and Jerseys the diminution continued through the third month. In the case of the Devons the per cent of fat increased gradually from the first month throughout the entire period of lactation, with some fluctuations. * * *

(3) The general tendency exhibited is a greater loss of fat in skim milk as lactation advances. This is especially noticeable in case of the Ayrshires and Devons, less so in case of the others. * * * In the case of the Jerseys and Holdernesses, we can not perceive that advancing lactation had any marked influence whatever upon loss of fat in creaming, while the increase of loss in the case of the Guernseys was slight. The milk richest in fat appears on the whole to be least influenced. * * *

The loss of fat in buttermilk is variable, and the variations as a rule appear to be independent of the influence of the period of lactation. * * *

Advancing lactation tends in some cases to diminish the amount of fat recovered, while in other cases the influence is slight or apparently nothing. * * *

No general statement regarding the influence of advancing lactation upon the amount of milk required to make a pound of butter can be made that will hold true of all the breeds. When the amount of fat in the milk increases less milk is required to make a pound of butter, provided the increased amount of fat is not lost in the skim milk and buttermilk. In the case of the Ayrshires, the amount of milk required to make a pound of butter gradually increases with advancing lactation. With the other breeds the tendency appears to be a slight fluctuation about a certain point or else a tendency to a slightly diminished amount of milk for making butter. * * *

With most of the breeds the largest milk yield was given in the second or third month, after which there was a gradual but not uniform diminution; with the Ayrshires the highest yield was in the fourth month, with the Guernseys in the seventh month.

In regard to yield of fat in milk, most of the breeds gave the largest yield in the second or third months, with a gradual but not uniform diminution afterwards. * * *

In regard to daily yield of butter, it was highest in the second month of lactation with the Ayrshires, Holdernesses, and Jerseys, after which there was a gradual diminution. The daily butter yield of the Devons increased during the first four months and then diminished. The butter yield of the Guernseys was uniformly the same during the first four months and reached its highest in the fifth month of lactation and then remained about the same as during the first four months up to the tenth month of lactation.

[The general tendency noticed was toward an increase in both the temperature and the length of time required for churning as the period of lactation advanced.]

Influence of advancing lactation upon production of cheese, L. L. VAN SLYKE (*New York State Sta. Report for 1891, pp. 387–389*).—The data here presented are all the result of calculations made on the basis of the experiment mentioned above. "It appears from the data that less milk is required to make cheese as the lactation period advances. * * * The monthly yield of cheese increased in most cases during the first two or three months of lactation and then gradually diminished. In the case of the Guernseys the yield increased during the first seven months and then slowly diminished."

How to ascertain the butter-making efficiency of milk fat, L. L. VAN SLYKE (*New York State Sta. Report for 1891, pp. 389–391*).—This is a popular discussion of the approximate relation between butter fat and butter and the difficulties of determining the butter-making efficiency of milk fat when the cream is raised by any of the gravity processes. The conclusion is reached that if methods of creaming or

churning are employed which do not give uniform results, or if butter is not uniformly salted and worked, "the amount of fat in the milk is no accurate guide as to the amount of butter that will be made from the milk."

Comparison of methods of creaming milk by setting and by centrifugal machine, L. L. VAN SLYKE (*New York State Sta. Report for 1891, pp. 391, 392*).—During one month the milk of ten cows was creamed by a Baby separator run at a speed of 6,200 revolutions per minute, and the results were compared with those obtained with the same cows in the preceding month by deep setting in Cooley cans, using ice. The following averages from ten cows indicate the difference in the results obtained by the two methods:

	Gravity method.	Baby separator.
Pounds of milk required to make 1 pound of butter	32.04	23.17
Per cent of milk fat recovered in cream	78 5	97.9
Per cent of milk fat recovered in butter	70.2	93.0
Pounds of butter per month	15.9	20.7

"In the case of one animal whose milk at all times has refused to cream by any gravity process employed, the yield of butter was increased from 13.9 pounds to 24.1 pounds by using the separator. The average gain was a little less than 5 pounds."

Comparison of dairy breeds of cattle with reference to production of cheese, L. L. VAN SLYKE (*New York State Sta. Report for 1891, pp. 364–369*).

Synopsis.—From the results of investigations of the milk of Jersey, Guernsey, Holstein, Ayrshire, Devon, and Holderness breeds of cows, reported above, an estimate is made of the amounts of cheese which the milk might be expected to yield. From the estimate it appears that for cheese production the Holsteins stand first, with the Guernseys closely following. The cost of food per pound of cheese was lowest with the Guernseys, Holsteins, and Ayrshires, in the order named.

In estimating the amount of cheese which could be made from the milk of the different breeds under investigation, the following basis of calculation is assumed:

(1) The loss of fat is made 7 per cent of the milk fat, when the milk contains on an average 1.2 pounds of fat, or less for 1 pound of casein and albumen, as in the case of the Ayrshires, Devons, Holdernesses, and Holsteins. The loss of fat is made 8 per cent of the milk fat when the milk contains on an average 1.4 pounds of fat for 1 pound of casein and albumen, as in the case of the Guernseys. The loss of fat is made 10 per cent when the milk contains on an average 1.5 pounds or more of fat for 1 pound of casein and albumen, as in the case of the Jerseys.

(2) The loss of casein and albumen is made uniformly 23 per cent of the casein and albumen contained in the milk.

(3) The other constituents of the cheese, as water, salt, and other ash constituents, sugar, lactic acid, etc., are calculated as being $4\frac{1}{2}$ pounds for the cheese made from 100 pounds of milk.

The calculation on this basis leads to the following average results:

Relative value of milk of different breeds for cheese-making.

Breed.	Average composition of milk.			Milk required to make 1 pound of cheese.	Average yield of cheese per month.	Cost of food per pound of cheese produced.
	Fat.	Casein and albumen.	Ratio of fat to casein and albumen.			
	Per cent.	*Per cent.*		*Pounds.*	*Pounds.*	*Cents.*
Jersey	5.68	3.76	1:1.50	8.00	56.14	7.95
Guernsey	5.02	3.60	1:1.40	8.40	59 60	6.61
Devon	4.46	3.81	1·1.17	8.64	41.32	8.20
Holstein	3.74	3.23	1·1.16	9.48	78.46	6.95
Holderness	3.60	3.19	1.1 13	9.72	46.28	7.48
Ayrshire	3.50	3.34	1:1.05	9.68	59.77	7.24

[With one exception] the yield of cheese by the different breeds corresponds to the amount of fat in the milk more closely than to the amount of casein and albumen; that is, the fat in the milk exercises a greater influence on the yield of cheese than do the other constituents of the milk. * * *

The Guernseys produce a pound of cheese at least food cost, and this was also true of the butter production of the Guernseys. The Holsteins and Ayrshires, which stood highest in the food cost of butter production, stand second and third in regard to the food cost of cheese production, while the reverse is true of the Jerseys and Devons.

The following table represents the profits, *i. e.*, the differences between the cost of food and the value of butter or cheese produced, for one period of lactation, allowing 25 cents per pound for butter and 10 cents per pound for cheese:

Profits from butter and cheese for each breed.

	Profits from butter for one period of lactation.	Profits from cheese for one period of lactation.
Ayrshires	$3.70 (6)	$16.47 (3)
Devons	4.30 (5)	7.62 (6)
Guernseys	27.60 (1)	20.20 (2)
Holdernesses	4.65 (4)	11.68 (4)
Holsteins	5.75 (3)	20.96 (1)
Jerseys	22.15 (2)	11.54 (5)

"From the foregoing table it appears that the Guernseys and Jerseys are by far the most profitable for butter production as compared with the other breeds, while for cheese production the Holsteins stand first, with the Guernseys closely following."

Experiments in the manufacture of cheese, L. L. VAN SLYKE (*New York State Sta. Report for 1891, pp. 220–299*).—A reprint of Bulletin No. 37 of the station (E. S. R., vol. III, p. 160).

STATION STATISTICS.

Report of executive committee of New York State Station (*New York State Sta. Report for 1891, pp. 1–7*).—Remarks on the work of the year and the needs of the station.

Report of treasurer of New York State Station, W. O'Hanlon (*New York State Sta. Report for 1890, pp. 8–10*).—This is for the fiscal year ending September 30, 1891.

Report of director of New York State Station, P. Collier (*New York State Sta. Report for 1891, pp. 11–181*).—This report includes a list of the bulletins published during the year; acknowledgments of gifts to the station; compiled statistics on the average yield per acre of principal farm crops from 1879–'89, and on the production and acreage under cultivation in New York as compared with the New England and Middle States; a discussion of these statistics; program of the Geneva dairy school held at the station August 24 to September 4, 1891; statistics of commercial fertilizers; and the discussion of experiments described under other headings. There is also a brief outline of experiments with fungicides carried on at this station under direction of the Division of Vegetable Pathology of this Department.

Reports of board of managers and director of the Rhode Island Station (*Rhode Island Sta. Report for 1891, pp. 3–21*).—General statements regarding the working force, work, equipment, and publications of the station. The terms are given of the arrangement with the State board of agriculture, under which the analyses connected with fertilizer inspection are made and published by the station. The permanent experimental plats laid out at the station are described and illustrated.

Report of treasurer (*Rhode Island Sta. Report for 1891, pp. 101–103*).—A statement of receipts and expenditures of the Rhode Island Station for the fiscal year ending June 30, 1891.

AGRICULTURAL STATISTICS.

Report of farmers' institute at Pomeroy, Washington (*Washington Sta. Bul. No. 5, May, 1892, pp. 85–103*).—This includes papers and discussions on the following subjects: State aid for the Agricultural College, by G. Lilley; Farm resources, by J. O'B. Scobey; Azoturia, by C. E. Munn; Farmers' sons, by F. W. D. Mays; and Trees and tree growth, by E. R. Lake.

Government direction of agriculture in Europe, J. E. Ray, Jr., (*Maryland Sta. Special Bul. H., July, 1892, pp. 8*).—A brief account of the methods adopted by European governments for the promotion of agriculture.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

The relations of soil to climate, E. W. Hilgard (*Weather Bureau, Bul. No. 3, pp. 59*).

Synopsis.—This subject is discussed under the following heads: The processes of soil formation, influence of climatic conditions on the physical character and chemical nature of soils and on the chemical processes in soils, and the alkali lands of arid regions.

This paper discusses from both a practical and theoretical standpoint some of the more important phenomena dependent upon the relation between climate and soil "and their effects upon the agricultural peculiarities of the chief climatic subdivisions." While data have been drawn from every available source, by far the larger proportion has been furnished by the author's extended studies of the soils of the United States. The incompleteness and inaccessibility of the data render gaps and omissions unavoidable, but the author expresses the hope that this first attempt at a systematic exposition of the subject "may serve at least the purpose of enlisting in the study of this the latest phase of chemical geology a larger number of active workers and observers, so that at least the large amount of information actually existing may be gathered together and made practically useful, thus leading the way to a better understanding of the character, capabilities, and needs of the lands of the various regions and of the means of utilizing them to the best advantage."

After a brief discussion of the agencies active in the formation of soils, and of the classification of soils, the author proceeds to the consideration of the climatic factors which modify soils. Of these temperature is of prime importance, for—

Within the ordinary limits of atmospheric temperatures all the chemical processes active in soil formation are intensified by high and retarded by low temperatures, all other conditions being equal. * * *

This being true, we should expect that the soils of tropical regions should, broadly speaking, be more highly decomposed than those of the temperate and frigid zones. While this fact has not been actually verified by the direct comparative chemical examination of corresponding soils from the several regions, * * * yet the incomparable luxuriance of the natural as well as the artificial vegetation in the tropics and the long duration of productiveness * * * offer at least presumptive evidence of the practical correctness of this induction. In other words, the fallowing action, which in temperate region stakes place with comparative slowness, necessitating the early use of fertilizers on an extensive scale, has been much more rapid and effective in the hot climates of the equatorial belt, thus rendering available so large a proportion of the soil's intrinsic stores of plant food that the need of

artificial fertilization is there restricted to those soils of which the parent rocks were exceptionally deficient in the mineral ingredients of special importance to plants that ordinarily form the essential material of fertilizers.

Water is a prominent agent in the process of soil formation and rainfall in connection with soil conditions is an important factor in determining the quality of agricultural soils. In regions of abundant rainfall an obvious result is the leaching out of the soluble constituents of rocks set free in the process of weathering.

When, however, the rainfall is either in total quantity or in its distribution insufficient to effect this leaching, the substances that otherwise would have passed into the sea are wholly or partially retained in the soil stratum, and when in sufficient amount may become apparent on the surface in the form of efflorescences of "alkali" salts. * * *

One of the most important modifications produced by scantiness of rainfall on soil formation is the great retardation of the formation of clay from feldspathic rocks (kaolinization) and the sediments derived therefrom.

As a result, it is observed that the soils of the Atlantic slope are prevalently loams, containing considerable clay, and even in the case of alluvial lands oftentimes very clayey or heavy, while the character of the soils of arid regions is predominantly sandy or silty, with but a small proportion of clay, unless derived, directly or indirectly, from preëxisting formations of clay or clay shales.

Not only is the proportion of clay greater in soils of humid regions than in those of arid regions, but its distribution is very different.

[In the former case] the clay, becoming partially diffused in the rain water when a somewhat heavy fall occurs, percolates through the soil in that condition and tends to accumulate in the subsoil, the result being that almost without exception the subsoils of the humid regions are very decidedly more clayey than the corresponding surface soils. * * *

Not only does this clay water tend to render the subsoil more compact and heavy, making it less pervious to water and air, but it is assisted materially in this by the action which tends to leach the lime carbonate out of the surface soil into the subsoil. The accumulated clay is thus frequently more or less cemented into a "hardpan" by lime partly in the form of carbonate and partly in that of zeolitic (hydrous silicate) compounds, adding to the compactness of the subsoil, and therefore to the usual specific difference between soil and subsoil, viz, the deficiency or absence of humus and the difficulty of penetration by an aëration of the roots of plants.

On the other hand, the soils of arid regions not being subject to this action of water, are in most cases of uniform chemical and physical condition to a great depth.

When vegetable matter decays under ground in well-drained soils the result is the dark soluble humus which is such a valuable addition to agricultural soils. When, however, decomposition is accomplished simply by the action of air assisted by an elevated temperature, the organic material is destroyed by a process of slow combustion (eremacausis), leaving practically nothing but the ash constituents of the original material.

It is easily seen that under the influence of hot, rainless summers the [latter] process * * * must prevail very largely, and that, exceptional circumstances apart, the pervious soils of the arid regions are likely to contain less humus than those of humid climates. Broadly speaking, actual examination amply proves this presump-

tion to be correct. * * * Few of the characteristic upland soils of the arid region contain over 0.40 per cent of true humus. The fruit growing "mesa" soils of south California mostly fall below 0.25 per cent. In the humid region of the cotton States 0.75 per cent is a common amount, and few even of the pine woods soils fall below 0.50 per cent.

Turning to a consideration of the more purely chemical processes in the soil as affected by climatic conditions, the first subject claiming attention is the leaching out of the calcium carbonate.

Although ordinarily considered insoluble in water when in the form of marble, limestone, or chalk, lime carbonate is yet sufficiently soluble in the soil water—always more or less charged with carbonic acid—to be materially affected by the leaching process. While much less soluble than the salts of potassium, sodium, or magnesium, and also less than gypsum or lime sulphate, yet the constant tendency is to leach it out of the surface soil into the subsoil, and from the soils of the uplands into those of the lowlands. * * *

This being so, it follows that in arid climates, in which the rainfall is insufficient to leach the soil even of its very easily soluble alkali salts, the lime carbonate must of necessity accumulate to even a greater extent than the former. We should therefore expect to find the soils of the region west of the one hundredth meridian in the United States, and generally those of arid regions everywhere, richer in lime than those of the humid regions, and particularly of those having abundant and frequent rains during a warm summer.

For the purpose of studying this question the author tabulates all the available analyses of soils from the humid and arid portions of the United States, respectively, excluding such as are not strictly comparable, as for instance analyses of soils from calcareous areas, which are omitted for obvious reasons. This table includes analyses of soils from the humid regions of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Kentucky, and Louisiana, and from the arid regions of California, Washington, Montana, Utah, New Mexico, Colorado, and Wyoming. The average results were as follows:

Average composition of soils in the humid and arid regions of the United States.

	Number of soils averaged.	Insoluble residue.	Soluble silica.	Total insoluble residue and soluble silica.	Potash.	Soda.	Lime.	Magnesia.	Brown oxide manganese.	Peroxide of iron.
Total for humid region	466	84.031	4.212	87.687	0.216	0.091	0.108	0.225	0.133	3.131
Averages by States	....	84.472	3.873	88.126	0.187	0.071	0.112	0.209	0.126	3.455
California	198	67.882	8.960	76.842	0.644	0.277	1.075	1.488	0.062	6.303
Washington	76	75.021	3.673	78.696	0.777	0.249	1.378	1.171	0.049	5.530
Montana	39	66.141	6.235	72.376	1.005	0.226	2.483	1.494	0.057	4.459
Total for arid region	313	70.565	7.266	76.135	0.729	0.264	1.362	1.411	0.059	5.752
Averages by States	....	69.681	6.289	75.652	0.825	0.251	1.645	1.384	0.056	5.431
Utah	1	79.20	4.70	83.90	0.709	0.404	1.237	0.848	0.019	7.770
New Mexico	1	63.20	7.32	70.52	0.732	0.176	10.060*	1.007	0.020	4.031
Colorado	1	69.61	11.12	80.73	0.964	0.113	0.706	0.845	0.006	6.640
Average of the three	....	70.67	7.71	78.38	0.801	0.231	0.971	0.900	0.015	6.147
Wyoming	9	75.79	2.45	78.24	0.72	0.47	2.67	1.45	....	3.32

*Omitted in average.

Average composition of soils in the humid and arid regions of the United States—Cont'd.

	Alumina.	Phosphoric acid.	Sulphuric acid.	Water and organic matter.	Total.	Hygroscopic moisture.	Temperature of absorption, C.	Soluble phosphoric acid.	Humus.	Carbonic acid.	Available inorganic matter.
Total for humid region	4.296	0 113	0.052	3 644	100.178	4.650	18.5	....	2.39	......	....
Averages by States ..	4.008	0 114	0.065	3.557	100 093	4 189	20.9	....	2.53	......	....
California	8.721	0.083	0 048	4 396	100 048	5 925	......	0 03	1.040	1.148	0 48
Washington	6 063	0.173	0 028	5.226	99.952	5 941	......	...	1 155	0.403	4.67
Montana	7.145	0.178	0.029	7.133	99.935	8.712	......	....	3.321	2.398	1.82
Total for arid region..	7.888	0 117	0.041	4.945	99 993	6.281	......	...	1.839	1.316	2.32
Averages by States .	7.309	0.144	0 035	5 585	99.978	6.859	......	....	1 830	1.316	2.32
Utah	1 477	0.160	0.003	3 707	100.232	....	....	....	....	......	....
New Mexico	2 560	0.103	0 082	3.197	99.849	....	......	....	....	......	....
Colorado	5 560	0.090	0.033	4.430	100.117	....	......	....	....	......	....
Average of the three .	3.199	0.117	0 039	3.778	100.099	....	......	...	....	......	....
Wyoming	5.85	0.18	0 10	4 79	99.69	....	......	...	....	1.90	....

Considering in this table first the ingredient under discussion above, viz, lime, a glance at the columns for the two regions shows a surprising and evidently intrinsic and material difference, approximating in the average by totals to the proportion of 1 to 12, in the average by States 1 to 14⅓. This difference is so great that no accidental errors in the selection or analysis of the soils can to any material degree weaken the overwhelming proof of the correctness of the inference drawn upon theoretical grounds, viz, that the soils of the arid regions must be richer in lime than those of the humid countries. * * * Now, if it be true that "a limestone country is a rich country" in the humid regions, and if, as the tables show, the soils of the arid regions are all calcareous to the extent to which that property serves its general purpose, then it must also be true that when the deficiency of rainfall in the arid regions is supplied by irrigation, the soils of the arid regions should be exceptionally productive as compared with those of the regions of summer rains.

I think experience shows that this is strictly true, and that in the arid region "poor" soils are very much less common than in the humid climates.

In humid regions there is always a marked difference between upland and lowland vegetation, that of the lowlands being generally such plants as the tulip tree or whitewood, black walnut, linden, etc., which flourish in limy soils, there being a marked difference in respect to the proportion of lime in hill and valley soils in such regions. In the arid regions, on the contrary, the uplands and lowlands being nearly equally calcareous, the differences observed are entirely referable to moisture conditions, for as soon as the uplands are irrigated the lowland flora, so far as it is distinct, takes possession.

Returning to a study of the tables, it is found that the differences observed for lime hold good for magnesia, showing that climatic influences have affected this element like the lime.

As a natural result of leaching out of the soluble elements, we would expect to find the soils of humid regions rich in the more insoluble constituents. The tables show that the difference is pronounced, the ratio

being substantially 70 per cent in arid regions to 84 per cent in humid regions.

The author's investigations have shown that a certain proportion of the alumina and silica in soil exists in the form of complex, easily decomposable silicates (zeolites). An examination of the table for soluble silica, which is an index of the amount of these zeolites present, will show that they are more abundant in soils of arid regions.

Nor should this be a matter of surprise when we consider the agencies which are brought to bear upon the soils of the arid regions with so much greater intensity than can be the case where the solutions resulting from the weathering process are continually removed as fast as formed by the continuous leaching effect of atmospheric waters. In the soils of regions where summer rains are insignificant or wanting, these solutions not only remain, but are concentrated by evaporation to a point that in the nature of the case can never be reached in humid climates. Prominent among these soluble ingredients are the silicates and carbonates of the two alkalies, potash and soda. The former when filtered through a soil containing the carbonates of lime and magnesia, will soon be transformed into complex silicates, in which potash takes precedence of soda, and which, existing in a very finely divided (at the outset in a gelatinous) condition, serve as an ever ready reservoir to catch and store the lingering alkalies as they are set free from the rocks, whether in the form of soluble silicates or carbonates. The latter have still another important effect: In the concentrated form at least they themselves are effective in decomposing silicate minerals refractory to milder agencies, such as calcic carbonate solutions; and thus the more decomposed state in which we find the soil minerals of the arid regions is intelligible on that ground alone.

But it must not be forgotten that lime carbonate, though less effective than the corresponding alkali solutions, nevertheless is known to produce, by long-continued action, chemical effects similar to those that are more quickly and energetically brought about by the action of caustic lime. * * *

In the analysis of silicates we employ caustic lime for the setting free of the alkalies and the formation of easily decomposable silicates, by igniting the mixture, but the carbonate will slowly produce a similar change, both in the laboratory and in the soils in which it is constantly present. This is strikingly seen when we contrast the analyses of calcareous clay soils of the humid region with the corresponding non-calcareous ones of the same. In the former the proportions of dissolved silica and alumina are almost invariably much greater than in the latter, so far as such comparisons are practicable without assured absolute identity of materials.

The data show no constant difference between the proportions of iron and phosphoric acid in the soils of the two regions, but as regards manganese, the proportion is much less in arid than in humid climates. Very great differences also are brought out in the average contents of potash and soda.

The process of "kaolinization," being that by which clays are formed out of feldspathic minerals and rocks, such as granite, diorite, trachyte, etc., results in the simultaneous formation of solutions of carbonates and silicates of potash and soda. These coming in contact with the corresponding compounds of lime and magnesia, also common products of rock decomposition, are partly taken up by the latter, forming complex, insoluble, hydrous silicate (zeolites). In these, however, potash whenever present takes precedence of soda, so that when a solution of a potash compound is brought in contact with a zeolite containing much soda the latter is partially or wholly displaced, and being soluble tends to be washed away by the rainfall into the country drainage. Hence, potash, fortunately for agriculture,

is tenaciously held by soils, while soda accumulates only where the rainfall or drainage is insufficient to effect proper leaching, and in that case manifests itself in the formation of what is popularly known as alkali soils, namely, those in which a notable amount of soluble salts exist, and are kept in circulation by the alternation of rainfall and evaporation, the latter causing the salts to accumulate at the surface and to manifest themselves in the form of saline crusts or efflorescences. * * *

Alkali lands are a characteristic feature of all regions of scanty rainfall, and are found on all the continents.

It appears that in California 20 inches of rainfall is the limit beyond which soluble salts can not be retained in the soil in considerable amounts.

[Investigations in other States] show that while the presence of alkali is dependent upon a certain deficiency of rainfall, yet that fact alone does not necessarily imply its presence to any practically important extent, the greater or less perviousness of the soil and of the substrata, as well as a certain slope of the surface, being effectual in counteracting the accumulation. Nevertheless, as the table of soil composition shows, such deficiency remains potent everywhere in bringing about the main characteristics of the soils of the arid region, to wit, high percentages of lime, magnesia, and potash, and relatively of soda.

A study of the distribution of the rains through the year [in India] seems to account for the inefficacy of the rains in leaching the soil of the northwest provinces of its surplus salts. Unlike the "Franciscan" type of climate, in which nearly all the rainfall is concentrated within a consecutive period of six months, during which the soil is constantly kept wet enough to permit of percolation downward, the rains of northwest India fall more or less in all months of the year save November, but usually in such small amounts that no percolation is brought about, save that in the months of July and August nearly half of the annual precipitation comes down in torrential form, ill calculated to produce more than a wetting of the soil to a depth whence capillary rise will again carry the soluble salts to the surface. * * *

The first touch of the water dissolves the salts, and the dry soil beneath instantly absorbs the solution, leaving the bulk of the water to flow by uselessly.

The composition of alkali in Europe, Asia, Africa, Australia, and the United States is shown in tables of analyses selected from different sources.

Of the accessory ingredients, those most manifestly dependent upon climatic conditions are the nitrates. It is well known that the process upon which their formation depends is materially conditioned upon a certain high temperature (about 75° F.); a moderate degree of moisture, permitting the easy access of air and forbidding the existence of reductive fermentations; the presence of calcic or magnesia carbonate; and, most of all, upon that of the "nitrifying organism," without which the other conditions are powerless to act. * * * We should expect to find nitrates scarce or absent where large percentages of carbonate of soda are found in the alkaline salts, and relatively abundant when sulphate and chloride are chiefly present. Actual examination fully confirms this *a priori* conclusion. The occurrence of nitrates in large proportion is confined to those regions in which white alkali is predominant; that is, neutral salts whose presence does not injure the activity of the nitrifying organism. * * *

Aridity is peculiarly favorable to the supplying of nitrogen to plants.

While the presence of potash is to some extent dependent upon the character of the country rock, being often very high where (true) granites contribute largely to the soils, yet its accumulation in the soils themselves seems to follow as a matter of

course along with and in preference to the sodium salts, the cause of the difference being its more tenacious retention by the soil. * * * There does not appear to be any relation between the amounts of potash present and the neutral or carbonated condition of the salts.

The slight solubility of earthy phosphates of necessity relegates the abundant occurrence of soluble phosphates to the cases where the salts are highly carbonated; it is therefore chiefly in the very black alkali that we find notable amounts of dissolved (sodic) phosphate.

The author discusses the theory of the formation of natural deposits of carbonate of soda.

There seems to be a consensus of opinion that the carbonation of the soda is connected in some way with the presence of limestone or carbonate of lime, and that an exchange has occurred in which either common salt or Glauber's salt have transferred their acidic components to lime and have become carbonates instead. * * * Yet the simple explanation of the contrary reaction was given and published as early as 1826 by Schweigger. In 1859 it was again observed by Alex. Müller, in a different form, but neither these chemists nor any of their readers appear to have perceived the important bearing of this reaction not only upon the formation of the natural deposits of carbonate of soda, but also upon a multitude of processes in chemical geology.

Without going into details, which have been published elsewhere,* it may be broadly stated that the formation of carbonated alkalies occurs whenever the neutral alkaline salts (chlorides or sulphates) are placed in presence of lime or magnesia carbonates and carbonic acid, or of alkali "supercarbonates" (hydrocarbonates) containing even a slight excess of carbonic acid above the normal carbonate, the latter being the actual condition of all natural sodas.

The reclamation of alkali lands is briefly discussed. Irrigation, underdraining, and applications of gypsum are means suggested. This subject has already been treated in detail in an appendix to the Annual Report of the California Station for 1890 (E. S. R., vol. IV, p. 120).

Crop report (*Division of Statistics, Special Report, July, 1892, pp. 275-296*).—This includes the following articles: European crop report for July, notes on foreign agriculture, Indian cotton crop for 1892, suspension of duties on corn imported into Mexico, removal of restrictions upon Russian grain exports, exports of corn, and transportation rates.

Crop report (*Division of Statistics, Report No. 98, n. ser., August, 1892, pp. 299-327*).—This includes the following articles: Primary prices of farm products; foreign trade in agricultural products, 1892; European crop report for August; notes on foreign agriculture; and transportation rates.

From the preliminary returns of the Bureau of Statistics of the Treasury Department, it appears that the foreign trade of the United States during the year ended June 30, 1892, aggregated $1,857,679,603, exceeding the largest trade of any previous year by more than $128,000,000. The trade of the year was made up of imports $827,401,573, and of exports $1,030,278,030. The exports were subdivided into domestic produce $1,015,732,011, and foreign exports $14,546,019. For the first time in the history of the foreign trade our exports of domestic produce amounted to more than $1,000,000,000. The balance of trade in favor of the United States was $202,876,457, against $39,564,614 last year, and an adverse balance of $2,730,277 in 1889,

*Proceedings of the American Association for the Promotion of Agricultural Science 1888 and 1890.

and $28,002,607 in 1888. In but three years in our history has the balance in our favor been so large. The increase in trade over the figures of the previous year was entirely in our exports, as the imports showed a slight falling off from the record of 1891.

Grouping the items of our domestic exports according to their origin, it appears that farm products furnished 78.1 per cent of the total trade, in value aggregating $793,717,676. This exceeds by more than $150,000,000 the value of our shipments of agricultural products in any single previous year and surpasses the record of 1889 by more than $260,000,000. It is actually greater by $63,000,000 than our total exports of all forms of production in 1889, and is greater than our total foreign trade, imports and exports combined, prior to 1870. The export trade in farm products has been segregated from the full trade returns of the past two years and is presented in full below. Separating the total trade in farm products into that made up of animals and their products, bread and breadstuffs, cotton and cotton-seed oil, and miscellaneous products, it appears that the exports under each head during the last four years have been—

	1889.	1890	1891	1892.
Animals and their products	$126 586, 103	$175, 986, 750	$178, 104, 333	$181, 718, 188
Bread and breadstuffs	123, 876, 661	154, 925, 927	128, 121, 656	290, 363, 117
Cotton and cotton-seed oil	239 073, 879	256, 259, 970	294 688, 203	263, 443, 526
Miscellaneous	40, 210 753	40, 044, 009	38, 524, 907	49, 192, 845
Total	529, 747. 396	627, 216, 656	639. 439, 099	793, 717, 676
Total exports	730. 282, 609	845, 293, 828	872. 270, 283	1, 015, 732, 011
Per cent agricultural	72. 5	74. 2	73. 3	78 1

The total import trade of 1892 aggregated $827,401,573. Segregating those articles which may properly be classed as agricultural, it appears that 51.6 per cent of our importation was made up of agricultural products, the aggregate being $427,933,311. This is an increase of $18,000,000 over similar imports in 1891 and of $53,000,000 over 1890. An examination shows the gratifying fact that this increase is almost entirely confined to such products as in no way compete with our own production. Excluding sugar and molasses, which under the present customs law occupy a somewhat peculiar position, it appears that in 1889 54 per cent of our agricultural imports could be properly classified as coming into competition with our own products, while in 1892 a similar division shows but 44 per cent competing.

Condition of growing crops (*Division of Statistics, Report, August, 1892, pp. 16*).—The crops included in this report are corn, spring wheat, rye, barley, buckwheat, oats, potatoes, cotton, grasses, sugar cane, sorghum, and fruits.

Insect Life (*Division of Entomology, vol. IV, Nos. 11 and 12, August, 1892, pp. 353–441, figs. 21*).—This double number, which concludes Volume IV, contains the following articles:

Some interrelations of plants and insects, C. V. Riley (pp. 358–378).—A paper discussing certain phases of plant fertilization by insects. A full description is given, with illustrations, of the Yuccas, the only plants depending for pollination upon a single species of insect; of the acts of pollination and oviposition by this insect—the *Pronuba yuccasella*, Riley; and of the bogus yucca moth, the *Prodoxus decipiens.* The article concludes with generalizations on fortuitous variations and transmissions of characters through heredity.

A new Icerya parasite, L. O. Howard (pp. 378, 379).—Note on a new species of Chalcid fly reared from the rose Icerya (*Icerya rosæ*). Characters of the genus are given and the species is described as *Cerchysius iceryæ.*

The West Indian rufous scale, T. D. A. Cockerell (pp. 380–382).—Notes on *Aspidiotus articulatus*, including a list of its food plants, an account of its habits and habitat, and a consideration of remedies. This scale insect has been found to infest orange, fig, olive, rose, cocoanut, and various other plants of the West Indies, and there is danger of its introduction into the United States.

Life history of Calothysanis amaturaria, Walk., a geometrid moth, A. S. Packard (pp. 382–384).—An illustrated account of the life history and descriptions of the earlier stages of *Calothysanis amaturaria.*

Steps towards a revision of Chambers's index, with notes and description of new species, Lord Walsingham (pp. 384, 385).—Notes on *Heliodines bella* and *H. extraneella*, and descriptions of the new species, *H. tripunctella*, *H. sexpunctella*, and *H. unipunctella.*

Sugar cane insects in New South Wales, A. Koebele (pp. 385–389).—An account of three kinds of insect enemies to the sugar cane in Australia, viz, a Noctuid larva, Scarabæid larvæ, and a wireworm or the larva of Diabrotica.

Notes on Lachnosterna, G. H. Perkins (pp. 389–392).—An account of a series of observations on several species of "white grubs," the larvæ of the Coleopterous genus *Lachnosterna.* These species considered are *L. dubia*, *L. fusca*, *L. grandis*, *L. arcuata*, *L. insperata*, and *L. rugosa.*

The first larval stage of the pea weevil (p. 392).—A short editorial note on the post-embryonic larva of *Bruchus pisi.*

Extracts from correspondence (393–399).—Under this general title letters are published on subjects of economic and popular interest. Among other subjects the following are treated: A Chalcid fly as a household pest; figs grown without caprification; blister beetles in Texas; the twelve-spotted asparagus beetle; a wood borer mistaken for a household pest; a new fruit pest, *Syneta albida*; the East Indian sugar cane borer; the horn fly in the South; grasshopper depredations in Ohio in 1891; tin-can remedy and paper wrappers for cutworms.

Notes from correspondence (399–401).—Of the notes under this heading the following are worthy of mention: A new peach pest—an undescribed scale-insect; myriopods injuring lettuce; quarantine decision in California—the quarantine officers had directed that 60,000 scale-infested orange trees be destroyed and legal proceedings were commenced by the owners, but the court ruled that they be all destroyed; importation of scale insect parasites; hop aphis remedies; note demonstrating the superiority of the kerosene emulsion to the quassia wash; *Oniscus* (sow bugs) damaging plants; clover leaf weevil in Connecticut; cutworms and wireworms damaging onions and celery; asparagus beetle in New

Hampshire, an extreme northern locality; and a new peach pest, *Anametis grisea*, a species of snout beetle.

General notes (pp. 402–411).—Among these were notes on the following subjects: The sugar cane pin borer, damage to boots and shoes by *Sitodrepa panicea*, feather felting, damage to carnations by the variegated cutworm, a larch enemy (*Coleophora laricella*), Hessian fly in New Zealand, increase of the wheat-straw worm, great damage by buffalo gnats, the hop louse in Oregon, and parasites of domestic animals.

Flax culture for fiber, C. R. DODGE (*Office of Fiber Investigations, Report No. 4, pp. 93, plates 2, figs. 12*).—This includes an account of field experiments with flax in 1891 at experiment stations and elsewhere in the United States; articles on flax culture in the Northwest, by E. Bosse; in Ireland and Belgium, by H. Wallace; in Austria-Hungary, by J. B. Hawes; and in Russia; and the statistics of flax culture in the United States, from Census Bulletin No. 177. The experiments in 1891 indicate that flax may be successfully grown for fiber in many localities in the United States. Especially favorable results were obtained in California and Oregon.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Determination of total nitrogen, HUGUET (*Jour. Pharm. et Chim., 27 (1892), No. 2, pp, 54-56*).—For determining nitrogen in compounds, especially of the pyridin and quinolin series, the author has adopted the following method: Put 10 grams of bisulphate of potash and 5 c. c. of sulphuric acid into a 150 c. c. flask, place the flask on a wire gauze in a very inclined position, and heat. When the mixture is boiling quietly the solution containing the compound in which nitrogen is to be determined is added very slowly, drop by drop. After all of the solution has been added it requires only a few minutes to obtain a clear solution. An excess of soda is then added and the ammonia distilled into a standard solution of sulphuric acid. The results obtained in a limited number of tests were very satisfactory. Determinations of nitrogen in a solution of acid sulphate of quinine gave the following results in two cases: Nitrogen found, 0.0406 and 0.0126 gram; calculated, 0.04088 and 0.01280 gram.—W. H. B.

Determination of nitrogen in nitrates, nitric ethers, and nitrogen derivatives by the Kjeldahl method, L. CHENEL (*Bul. Soc. Chim. de Paris, 7-8 (1892), No. 11, pp. 321-327*).—The reactions which take place in the Jodlbauer modification of the Kjeldahl method are thus explained: When the nitrate is dissolved in the acid mixture the NO_2 group combines with the phenol to form mononitrophenol, which is reduced by the zinc to an amide derivative, and during the combustion the nitrogen of this amidophenol is transformed to ammonia.

It is essential in this process that only the mononitrophenol should be formed, since tests showed that while 0.5 gram of mononitrophenol dissolved in 30 c. c. of pure sulphuric acid, reduced by powdered zinc, and heated with 0.7 gram of mercury, yielded practically the theoretical amount of nitrogen (10.03 per cent); trinitrophenol treated in the same manner yielded only 16.23 to 16.46 per cent, the theoretical amount being 18.34 per cent.

Nitrates, ammonia compounds, nitric ethers, and nitrogen derivatives and amide compounds of the aromatic series dissolved readily in the acid mixture* and yielded practically the theoretical amount of

*Prepared as follows: Dissolve 140 grams of phenic acid (39°-40°) in 2 liters of sulphuric acid in the cold, and 54 grams of phosphoric anhydride in 2 liters of sulphuric acid, and mix the two solutions.

nitrogen, as the following results, obtained with carefully purified compounds, show:

Determinations of nitrogen by the Jodlbauer modification of the Kjeldahl method.

Substance.	Per cent of nitrogen.		Greatest error.	Average error.
	Theoretical.	Found.		
Nitrate of potash	13.86	13.91 13.82 13.73 13.96	$\frac{1}{107}$	$\frac{1}{1300}$
Nitrate of ammonia	35 00	35.31 34.90 34.96	$\frac{1}{113}$	$\frac{1}{230}$
Nitrate of barium	10 72	10.67 10.62	$\frac{1}{107}$	$\frac{1}{140}$
Nitrate of methylamine	29.79	29.65 29.68	$\frac{1}{212}$	$\frac{1}{210}$
Nitroglycerin	18.50	18.45	....	$\frac{1}{370}$
Binitrobenzine	16.67	16.78 16.57	$\frac{1}{130}$	$\frac{1}{150}$
Paranitrophenol	10.07	10.03	....	$\frac{1}{250}$
Picric acid	18.34	18.42 18.17 18.43	$\frac{1}{105}$	$\frac{1}{300}$
Picrate of ammonia	22.76	22.63 22.67	$\frac{1}{175}$	$\frac{1}{205}$
Picramic acid	21.10	21.00 20.69	$\frac{1}{50}$	$\frac{1}{80}$
Picramate of ammonia	25.90	25.45 25.75	$\frac{1}{60}$	$\frac{1}{90}$
Binitroörthocresol	14.14	14 10 13.98	$\frac{1}{80}$	$\frac{1}{140}$
Trinitrometacresol.	17.27	17.37 17.27	$\frac{1}{195}$	$\frac{1}{315}$

It was found that the method was not accurate when applied to nitrogen derivatives of naphthalines, but that by first reducing the nitronaphthalines to naphthylamines exact results could be obtained. This may be accomplished as follows: To 2 grams of phosphorus dissolved in 15 to 20 c. c. of bisulphide of carbon in a 250 c. c. flask add slowly 12 grams of iodine. Heat the flask with agitation on a boiling water bath. The iodide of phosphorus is deposited as a coating on the sides of the flask, which is heated four or five minutes longer to expel the last trace of bisulphide of carbon. On cooling and under the action of moist air the iodide may be detached and broken into small fragments by shaking the flask. Weigh out 5 to 6 decigrams of the substance to be tested on a long narrow scoop and introduce it into the flask, being careful to prevent particles from adhering to the neck. Add 8 c. c. of water and shake the flask to insure thorough mixing. The reaction commences almost immediately and in a few minutes is finished. The flask now contains a solution of acid iodohydrate of naphthylamine, and it only remains to cool the flask and keep it so while 25 c. c. of 66° sulphuric acid is slowly added and 0.7 gram of mercury is measured into it from a capillary pipette. The operation then proceeds as usual. As shown below, the nitrogen derivatives of the aromatic series, as well as the nitronaphthalines, are equally susceptible of exact analysis by this method.

Determination of nitrogen in compounds of the aromatic series.

	Per cent of nitrogen.		Greatest error.	Average error.
	Theoretical.	Found.		
Binitrobenzine	16.67	16.70 16.52	$\frac{1}{110}$	$\frac{1}{183}$
Picric acid	18.34	18.26 18.18	$\frac{1}{115}$	$\frac{1}{155}$
Picrate of ammonia	22.76	22.86 22.65	$\frac{1}{175}$	$\frac{1}{200}$
Picramic acid	21.10	20.90 21.03	$\frac{1}{100}$	$\frac{1}{150}$
Picramate of ammonia	25.90	25.60	....	$\frac{1}{85}$
Binitroörthocresol	14.14	14.12 14.02	$\frac{1}{115}$	$\frac{1}{200}$
Trinitrometacresol	17.28	17.05 17.26	$\frac{1}{75}$	$\frac{1}{140}$

Determination of nitrogen in nitronaphthalines.

	Per cent of nitrogen (average).		Greatest error.	Average error.	Number of determinations by modified method.
	Schlösing's combustion method.	Modified Jodlbauer method.			
A	17.36	17.19	$\frac{1}{123}$	$\frac{1}{215}$	7
B	15.08	15.16	$\frac{1}{100}$	$\frac{1}{110}$	5
C	16.40	16.17	....	$\frac{1}{140}$	2
D	16.96	16.77	....	$\frac{1}{400}$	2
E	15.84	15.80	....	$\frac{1}{220}$	2
F	16.08	16.14	....	....	1
G	15.82	15.44	....	....	1

The results show that the Kjeldahl method with its modifications is as widely applicable as the Dumas method. It is, besides, convenient and rapid.

Comparative tests of saturating the acid completely with sodium hydrate at one operation, and of nearly neutralizing the acid, cooling the flask, and attaching it to the distilling apparatus immediately after completing the neutralization, gave identical results.—W. H. B.

A new method of organic analysis, BERTHELOT (*Bul. Soc. Chim. de Paris, 7–8 (1892), No. 13, p. 430*).—The author explains that the method of combustion in a calorimetric bomb, which has already been described in *Comptes rendus*, 114, p. 317 (E. S. R., vol. III, p. 818), is also applicable to the determination of chlorine. For this purpose a solution of arsenious acid is placed in the bomb in advance of the operation, and in case of substances very rich in chlorides a sufficient quantity of camphor is added.—W. H. B.

The application of the centrifuge in analytical and microscopical work, second paper,* W. THÖRNER (*Chem. Ztg., 1892, pp. 1101–1104*).—The author makes use of the centrifuge in the determination of the fat in milk and dairy products, the cream content of milk, and the water content of butter and other fats; in the analysis of butter,

*An abstract of the first paper was given in E. S. R., vol. III, p. 488.

margarin, etc.; in the examination of flour, of milk for tuberculosis bacilli, and of water; and in the volumetric determinations of precipitates, etc. In these operations he uses tubes of several different forms, but which in general are of two classes, viz, those with a narrow graduated neck at the bottom and those with the graduated neck at the top of the tube, the shape of the tube depending upon the material to be tested. The tubes are suspended in a frame within the case of the centrifuge, hanging in a vertical position when at rest and assuming a nearly horizontal position when in motion. Some of the smaller tubes are placed within a second tube to prevent breaking when they are whirled.

Determination of fat in milk and dairy products.—For the determination of fat in milk 10 c. c. of milk are mixed in the tube with 1.5 c. c. of alcoholic potash solution containing 160 grams of potassium hydrate per liter, or with 1 c. c. of an aqueous potash solution containing 500 grams of potassium hydrate per liter. The tube is then closed with a rubber stopper carrying a small tube which is closed by a rubber tube and pinchcock, and is then heated in a boiling water or steam bath for two or three minutes. The tube is closed during heating to prevent loss of material from frothing. The tube is then shaken, about 1 c. c. of glacial acetic acid is added, again shaken, and acetic acid then added until the mixture reaches the zero point in the tube. The tube is then closed as before, heated in a water bath for a few minutes, and then whirled in the centrifuge for two minutes at a rapidity of 2,000 to 3,000 revolutions a minute. Following this the tube is heated for about five minutes in a boiling water bath and the fat read off while hot. Eight determinations are easily made in twenty minutes, and the results are said to be very satisfactory.

Determination of the cream content of milk.—This is done by filling the tube to the zero mark with milk and whirling the centrifuge for from ten to fifteen minutes, after which the volume of cream is read off; or, better, by diluting the milk one half with water and then whirling for ten minutes.

The method of analysis of butter was described in the first article, as well as that of the examination of flour.

Examination of water.—In the examination of water for disease germs, 100 c. c. are whirled for ten minutes. In order to aid the precipitation of the bacilli, very fine sterilized clay is added to the water. The supernatant liquid is siphoned off from the sediment, 30 to 50 c. c. of distilled water added, again whirled, and the water siphoned off. From the sediment, which should contain all of the bacteria originally in the water, plate cultures are made.

Volume of precipitates.—The volume of precipitates is determined by making the precipitation in the centrifuge tube, whirling for several minutes, and then reading off from the graduated scale on the narrow part of the tube. By just what determinations this could be made use of is not plain.

A description of the author's method of examining milk for tuberculosis germs was given in vol. IV, p. 214 of the Record.—E. W. A.

On the passage of dissolved substances through mineral filters and capillary tubes, C. CHARBIE (*Compt. rend., 115 (1892), pp. 57–60, figs. 2*).—Former work by the author has established the following facts: (1) On filtering an albuminous urine through porcelain the urea passed through more readily than the albumin; (2) when blood freed from fibrin was filtered under the same conditions there was obtained first a liquid very poor in albumin and free from hæmoglobin and finally one quite rich in hæmoglobin; (3) when a solution containing urea and uric acid was filtered both substances passed through with equal rapidity.

In the first experiment therefore it was observed that of two substances, one of small and the other of large molecular volume, the substance of large molecular volume filtered more slowly. In the second experiment, of two substances, both of large molecular volume, the one of larger volume passed through more slowly. In the third case with two substances, both of which were of small molecular volume, no appreciable difference in rapidity of filtration was observed.

The author has carried his investigations further, substituting a very fine capillary tube for the filter of porous earthenware. The results obtained with solutions of albumin of different strengths in capillary tubes of different diameters confirm those stated above. The apparatus used is illustrated.—W. H. B.

The nourishing of green parts of plants with formic aldehyde, T. BOKORNY (*Landw. Jahrb., 21 (1892), pp. 445–466*).—The synthesis of the carbohydrates in plants has been an object of much study and speculation. It has been experimentally demonstrated that they are formed under the influence of light and chlorophyll bodies from carbonic acid and water by a union of the two, as a result of which free oxygen is given off. Further than this little has been known with certainty. The formula usually given for the reaction is familiar. It supposes that—

$$6\ CO_2+5\ H_2O=C\ 6\ H_{10}O_5+12\ O;$$
$$6\ CO_2+6\ H_2O=C\ 6\ H_{12}O_6+12\ O, \text{etc.}$$

Baeyer, a German chemist, suggested the theory that the carbonic acid and water first united to form formic aldehyde, CH_2O, and that from this substance the different carbohydrates were formed by condensation. But the hypothesis has lacked experimental proof, for although aldehyde-like substances were believed to be found in the leaves of plants, and sugars have been synthetically prepared in the laboratory from formic aldehyde, no starch has been formed when leaves were placed in solutions of formic aldehyde and kept under exclusion of carbonic acid. Where plants have been grown in carbonic-acid-free air in nutritive solutions containing various kinds of sugar, glycerin,

methyl alcohol, etc., starch has been formed. This has strengthened the belief that plants might be nourished with organic bodies.

As all previous experiments in which formic aldehyde solutions were used directly had resulted in failure, the author employed formic-aldehyde-sodium-sulphite, a material which low heat or the action of plants readily decomposes into formic aldehyde and acid sulphite of soda. But as the latter decomposition product is injurious to plants it was necessary to add sodium phosphate to correct this. Further than these substances the nutritive solution contained mineral ingredients in the form of calcium nitrate, potassium chloride, magnesium sulphate, monopotassium phosphate, and iron chloride (trace).

The plants used were algæ, varieties of *Spirogyra* and *Zygnema*. The assimilation of carbonic acid from the air was prevented by the total exclusion of carbonic acid in some cases, and in others by using a nutritive solution free from potassium, since Nobbe has shown this element to be essential to assimilation. In order to trace the formation of organic matter in the plants they were in some trials rendered starch-free by monosodium phosphate; in others the increase in weight of the dry matter of the plant was noticed.

The plants were placed in nutritive solutions both with and without the formic-aldehyde-sodium-sulphite. There was an extensive formation of starch in the case of both algæ wherever the formic-aldehyde-sodium-sulphite was used. This was evident both from the microscopic tests for starch and the increased weight of the plants. It was found further that the amount of formic-acid salt in the nutritive solutions diminished noticeably as the plants grew. The experiments were so thoroughly controlled in every particular that it seemed evident from the results that formic aldehyde had been used by the plants to form starch.

The following résumé is by the author: Green plant cells can utilize formic-aldehyde-sodium-sulphite in the formation of starch, decomposing this salt and condensing the formic aldehyde set free. In this synthesis light plays an important part, the formation of starch being greater or less according as the light is more or less intense. In a good light and under total exclusion of carbonic acid, starch is formed very rapidly in plants which have been rendered starch free, and the starch may be stored up in considerable amounts. The plants also increase in weight of dry matter. The reducing power of the nutritive solution containing formic-aldehyde-sodium-sulphite, as shown by potassium permanganate, decreased rapidly when *Spirogyra* was grown in it, indicating that the salt was being used by the plant.

This experimental evidence of the formation of starch in the plant from formic aldehyde lends to the Baeyer hypothesis a degree of probability never enjoyed before. Although only a part of the process can be followed, and no formic aldehyde can be detected in the green plant cells as proof that the assimilated carbonic acid is first changed to formic aldehyde, it is believed that this need not detract from the

plausibility of this theory. Formic aldehyde being exceedingly active does not remain as such in the cell, but is converted at once into more complicated compounds, and does not collect in sufficiently large amounts to be recognizable. The collection of minute quantities of free formic aldehyde would be dangerous to the plant, since, as previously shown by the author, it is very poisonous to plants.—E. W. A.

Chemical composition of peptones, P. SCHUTZENBERGER (*Compt. rend., 115 (1892), No. 4, pp. 208–213*).—Fibrin of horses' blood, well washed and pressed, was treated while still moist in portions of 350 grams, corresponding to 75.5 grams of dry fibrin, with 2.5 liters of distilled water at 40° C. containing 12 c. c. of pure concentrated hydrochloric acid. The product swelled up immediately and became transparent and gelatinous; 7.5 grams of 100 per cent pepsin extract dissolved in 50 c. c. of lukewarm water was then added. In less than one minute the swelled and gelatinous mass was completely liquified. The whole was then poured into a flask. Ten c. c. of 20 per cent prussic acid was added to prevent microbic changes, and the solution was maintained at a temperature of 40° C. for five hours. In this manner there was obtained a limpid liquid almost colorless, at the bottom of which was a light, flocculent, brownish deposit. The weight of this floccular residue, which contained the fat, a little hematin, and probably the nuclein, represented 4 to 4.7 per cent of the dry fibrin used. The solution exhibited the characteristic reactions of peptones prepared from albuminoids. The hydrochloric acid added at the beginning of the operation was removed by a strictly equivalent amount of oxide of silver. The chloride of silver was separated out by heating in a water bath and the clear solution was filtered. The filtrate was neutral to reagent paper. It was evaporated in a water bath to a sirupy consistence and afterwards evaporated to dryness in a vacuum. The friable mass thus obtained was pulverized and left for a few days in the dessicator and then weighed. The brownish powder resulting is designated fibrin-peptone. This fibrin-peptone thoroughly dried in a vacuum showed the following composition (deducting the ash), which, as will be seen, approaches closely that of the amphopeptone of Kühne and Chittenden:

	Fibrin-peptone.	Amphopeptone.
	Per cent.	*Per cent.*
Carbon	49.18	48.75
Hydrogen	7.09	7.21
Nitrogen	16.33	16.26
Oxygen	27.40	27.01
Sulphur		0.77

The fibrin-peptone was heated at between 150° and 180° C. for six hours with three times its weight of barium hydrate. The products of the reaction were as follows: Ammoniacal nitrogen 4.1 per cent, carbonic acid 5.94 per cent, acetic acid 3.16 per cent, and fixed residue 87.82 per cent.

The sum of the products found is practically equal to the original weight of fibrin-peptone, 99.35 per cent. These results seem to indicate that no water is fixed during the decomposition of the fibrin-peptone under the influence of baryta. The elementary analysis of the fixed residue from the baryta, deducting ash, was as follows:

	Per cent.	
	Found.	Calculated.
Carbon	47.52	47.35
Hydrogen	7.61	7.47
Nitrogen	12.93	12.93
Oxygen	31.94	32.25

The fixed residue obtained with baryta is a mixture of variously constituted amides, largely crystallizable, and of the same nature as those obtained from fibrin directly by the action of baryta. This confirms the statements of Meisner, Kühne, and Chittenden that fibrin-peptone is not a homogeneous product.—W. H. B.

Fixation of the ammoniacal nitrogen of gas liquor by straw, DE VOGÜÉ (*Compt. rend., 115 (1892), No. 1, pp. 25, 26*).—The ammoniacal waters from the manufacture of gas at Cosne contain on the average 13 grams of ammonia per liter, of which 9 grams are combined with carbonic acid and 4 with sulphur, cyanogen, and other bodies whose determination is not of interest in this connection. Applied to dry fields at the rate of 25 cubic meters per hectare, these waters very largely increase the yield.

With a view to storing their nitrogen during the seasons when these waters could not be applied and to putting them into a form applicable to the culture of cereals, it was decided to mix them with straw to produce an artificial manure.

For this purpose 2,500 kg. of straw was saturated with 9,000 liters of the waters in an apparatus which permitted the temperature to be observed and the gaseous products to be analyzed. At first violent oxidation took place, accompanied by a decided elevation of temperature, with evolution of carbonic acid and much vapor of water. The maximum intensity of reaction in the pile of manure was reached at the thirteenth day. The gas evolved contained 32 per cent of carbonic acid and only traces of oxygen. The temperature exceeded 100° C. The liquid which came off from the mass was strongly colored black. Treated with acids, there was precipitated a black, flocculent material, which was soluble in potash and presented the appearance of the black substance from animal manure.

After the thirteenth day the reaction diminished in intensity, but the evolution of carbonic acid continued with decreasing activity to the end of the operation, which was complete in about four and a half months. The mass had decreased in weight 4,200 kg., or a little more than one third. It presented the appearance of half-rotted black manure.

Samples of the artificial manure taken on the thirty-third day of the operation were analyzed by Schlösing, with the following results: Water 80 per cent, dry matter 20 per cent. The nitrogen content of 100 grams of the fresh manure was:

		Milligrams.
Nitrogen ...	evolved in drying at 100° C	67.16
	retained in combination	129.72
Organic nitrogen		483.31
Total		680.19

The better quality of natural manure contains less than four to five thousandths of nitrogen. The artificial manure, therefore, is richer than the natural up to the thirty-third day. At the end of the operation it is calculated that only the initial amount of nitrogen was fixed, but it is possible that by shortening the duration of the fermentation and modifying the reaction a higher result might be obtained.

Another point of interest observed was the reaction between the carbonate of ammonia of the liquor and the organic matter of the straw. The complex black substances mentioned above are formed and combine with a part of the ammonia. Carbonic acid is set free from this source as well as by slow combustion of the straw.

From a practical standpoint the experiments are of interest, as indicating a convenient means of utilizing these ammoniacal liquors on farms in the vicinity of gas works.—W. H. B.

The comparative nitrification of humus and unaltered organic matter, and the influence of the proportion of nitrogen in humus on nitrification, P. PICHARD (*Ann. Agron., 18 (1892), No. 7, pp. 337–351*).—This comparison was made on mixtures of sand with two vegetable molds containing respectively 3 and 5 grams per kg. of nitrogen and with cotton-seed meal.

Six experiments with each mixture were made, (1) the plain soil mixture, (2) soil mixture with 2 per cent of carbonate of lime, (3) soil mixture with 0.2 per cent of caustic lime, (4) soil mixture and 0.5 per cent of plaster, and (6) soil mixture and 2 per cent of carbonate of lime and 0.5 per cent of plaster. The mixtures were placed in brown glass jars which were arranged so as to allow of the circulation of air and water through the soil, the method of procedure being the same as that described in former papers by the author.* The experiments lasted from June 2, 1891, to February, 1892, and the results are tabulated in full. The author's summary of results is substantially as follows:

The humous soil gave considerably less nitric nitrogen than the cotton-seed meal mixture under like conditions. In the three series the minimum of nitrogen was produced in the soils to which no lime compounds had been added, 3.48–4.20 per cent of the initial nitrogen in soils containing humus, 16.18 per cent of that in the cotton-seed meal

*Compt. rend., 114 (1892), p. 81 (E. S. R., vol. III, p. 636); Ann. Chim. et Phys., 25 (1892), p. 271 (E. S. R., vol. III, p. 917).

mixture. The maximum was obtained in soils containing carbonate of lime and plaster, with humus, 10.15–10.40 per cent; in cotton-seed meal soil, 7.40 per cent. The next lower results were with carbonate of lime, with humus, 9.65–9.98 per cent; in cotton-seed meal soil, 22.35 per cent. In the humous soil the mixture of lime and plaster gave 8.85-8.93 per cent. Lime alone with humus, 7.60–8.08 per cent, with cotton-seed meal, 19.84 per cent. The gypsum alone furnished more than the lime in the cotton-seed meal mixture, 21.10 per cent; and less than the lime with humus, 6.26–7.04 per cent. The production of carbonate of ammonia and nitrification are quite slow in the humus, but in cotton-seed meal under the action of lime or carbonate of lime the formation of carbonate of ammonia proceeds more rapidly than nitrification, and there is consequently a considerable loss of ammonia. Where plaster is used this carbonate is converted to sulphate and loss of ammonia prevented. As gypsum with humous soils gives an acid reaction which interferes with nitrification, it is well to apply it in connection with lime or carbonate of lime.

The amounts of nitrogen nitrified in two humous soils containing the same initial proportion of nitrogen were practically identical, showing a certain constancy or fixity of composition of the humus. The absolute amounts of nitric nitrogen formed increased with the initial amount of nitrogen, but the ratio decreased.

		Per cent.	
Soil with carbonate of lime..	1 gram nitrogen per kg	9.65	9.98
	3 and 5 grams nitrogen per kg	3.67	2.94
Soil with carbonate of lime and plaster.	1 gram nitrogen per kg	10.15	10.40
	3 and 5 grams nitrogen per kg	4.53	3.48

With the cotton-seed meal mixture the results were even more striking.

In spite of the slow nitrification of the humus in sandy soils poor in calcareous matter, there is still sufficient nitric nitrogen for the needs of vegetation if a large proportion is not lost in the drainage.

The mixing of gypsum and carbonate of lime (preferably marl) with composts (1 to 2 kg. of plaster to 1 c. m. of compost) which are to be applied to the soil in the spring, is recommended as the most feasible plan for promoting nitrification and preventing loss of ammonia, both in the manure and in the soil.—W. H. B.

Contribution to the study of drainage waters of bare soils, third paper, P. P. DEHÉRAIN (*Ann. Agron., 18 (1892), No. 6, pp. 273–299*).—The methods employed in this inquiry were explained in detail in previous papers. The observations recorded in this article were made on 14 samples of soil in large earthenware pots, and extended over the period from March, 1891, to March, 1892. They relate to (1) the relation between rainfall and drainage, (2) the nitric nitrogen in the drainage waters of unmanured soils, (3) the amount of nitric nitrogen per cubic meter of drainage water, (4) the nitric nitrogen in manured soil, and (5) the nitric nitrogen in drainage waters at different seasons of the year.

Rainfall and drainage.—The observations of rainfall and drainage calculated to millimeters are recorded in the following table:

Rainfall and drainage from March, 1891, to March, 1892.

	Spring.	Summer.	Autumn.	Winter.	Whole year
Rainfall	176.2	170.7	91.7	125.0	563.7
Drainage (average of fourteen pots)	74.3	55.1	62.3	112.0	293.7
Ratio	2.5	3.1	1.4	1.1	....

Comparing the ratios of drainage to rainfall for the different seasons of the above-mentioned period with those of previous years, we have the following results:

Ratio of drainage to rainfall during different seasons and years.

Season.	Year.	Ratio.
Spring	1890	Rainfall.. 152.5 / Drainage. 46.6 = 3.2
	1891	Rainfall.. 176.2 / Drainage. 74.3 = 2.5
Summer	1889	Rainfall.. 164.0 / Drainage. 7.6 = 21.5
	1890	Rainfall.. 100.8 / Drainage. 58.9 = 1.7
	1891	Rainfall.. 170.8 / Drainage. 55.1 = 3.1
Autumn	1889	Rainfall.. 79.5 / Drainage. 59.5 = 1.3
	1890	Rainfall.. 97.3 / Drainage. 26.5 = 3.6
	1891	Rainfall. 91.7 / Drainage. 62.3 = 1.4
Winter	1889–'90	Rainfall.. 105.5 / Drainage. 76.6 = 1.4
	1891–'92	Rainfall.. 125.0 / Drainage. 112.0 = 1.1

The differences in amounts of drainage on manured and unmanured soils were as follows:

	Manured.	Unmanured.	Difference.
Grignon	315.3	277.1	+38.0
Wardrecques	259.6	251.3	+ 8.3
Marmilhat	332.7	327.7	+ 5.8
Palbost	340.0	373.8	−33.8

The Marmilhat and Palbost soils are black, rich in organic matter, and very permeable. This probably partially explains the exceptional results, particularly in case of the latter.

Nitric nitrogen in the drainage waters of unmanured soils.—The drainage water was collected and analyzed for nitrates thirteen times during the year. Calculating the amount of nitric nitrogen in the drainage water on the basis of kilograms per hectare, we have the following results:

Nitric nitrogen in the drainage waters of unmanured soils.

	Kg per hectare.
Grignon meadow	78.52
Grignon in good condition	115.95
Grignon exhausted	74.70
Wardrecques	73.80
Blaringhem	112.60
Marmilhat	62.06
Palbost	63.44

These figures are much higher than those obtained by Warington at Rothamsted, 1877 to 1886. His average was 44 kg., as compared with 83.01 kg. obtained in this experiment. For the purpose of illustrating the variation in nitrification in the same soil during different years, the amounts of nitric nitrogen in the drainage waters during the period of March to November, 1890 and 1891, are compared in the following table:

	1890.	1891.	Total, 1890 and 1891
Wardrecques	152.4	58.2	210.6
Blaringhem	128.1	92.9	221.0
Marmilhat	62.5	49.9	112.4
Palbost	45.0	51.3	96.5
Average	97.0	63.0	....

Since the conditions in 1891 were fully as favorable to nitrification as in 1890, it was thought probable that the decrease in the amount of nitrates was due to the disappearance of the readily nitrifiable material. It appears that in a bare soil of average fertility 1 per cent of its combined nitrogen is transformed into nitric nitrogen during one year, but this transformation is very variable in different soils. For example, the Blaringhem soil, which produced the greatest total amount of nitric nitrogen in 1890 and 1891, was in this respect inferior to the Wardrecques soil in 1890 and superior to it in 1891. It has been observed in culture experiments on the Wardrecques soil that a full return is not obtained unless the crop immediately follows a liberal manuring. The Marmilhat and Palbost soils showed similar ability to preserve their fertility from waste by drainage.

Amount of nitric nitrogen per cubic meter.—The amount in grams per cubic meter of nitric nitrogen in the different drainage waters was as follows:

Nitric nitrogen per cubic meter of drainage water from different soils.

Grignon, meadow	31.1
Grignon, without fertilizer	51.7
Grignon, manured	69.9
Grignon, exhausted	31.0
Grignon, manured	57.0
Grignon, liquid manure	59.4
Grignon, liquid manure without NH_3	61.3

Wadrecques, without fertilizer	33.0
Wadrecques, manured	55.0
Blaringhem, without fertilizer	39.0
Marmilhat, without fertilizer	18.9
Marmilhat, manured	38.7
Palbost, without fertilizer	17.6
Palbost, manured	34.3
Mean	42.9

The average for all the unmanured soils is 31.7 grams, as compared with 21.95 grams, found by Frankland on similar soils at Rothamsted, while the amounts yielded by the Palbost and Marmilhat soils are smaller than Frankland's figures. This is explained by the facts that these soils were very poor, nitrification was less active, and drainage more abundant.

Nitric nitrogen in manured soils.—Five pots containing different soils received manure of the same amount and kind, five duplicate pots of the same soil remaining unmanured. The amounts of nitric nitrogen from the different pots during the year, calculated to kilograms per hectare, were as follows:

Nitric nitrogen in manured soils.

	Manured.	Unmanured.	Difference.
Grignon	194.52	116 95	78.57
Grignon	143.16	74.70	68 56
Wardrecques	130.48	73.80	56 28
Marmilhat	121.56	63.06	59.56
Palbost	106.44	63.44	43.00

We see here a relation between the rapidity of drainage and activity of nitrification. The Grignon soil contains more water than the Marmilhat, but the Wardrecques soil, which retains it very well, nitrifies the nitrogen of the manure less readily than the Marmilhat soil, which parts with its drainage waters rapidly. During the year the Grignon soil nitrified a third to a fourth of the nitrogen applied, the Wardrecques and Marmilhat soils a fifth, and the Palbost soils only a seventh. It is evident that if a large application of manure is made on the Grignon soil there is a risk of a considerable loss of nitrogen. It is probable that a large fraction of the 194 kg. of nitrogen formed during the year in the manured soils, and the 143 kg. formed in the unmanured soil would not be entirely utilized by the crop and would be lost in the drainage. Liberal manuring might be practiced with less danger on the Marmilhat or Palbost soils, where nitrification is slower.

In general, in the manured soils the largest amounts of nitrates were found between March 1 and 24. The soils receiving untreated liquid manure and liquid manure from which the ammonia had been removed gave results practically indentical throughout the year, the largest amounts of nitrates being produced October 11 to 26, although

nitrification seemed to be somewhat delayed at first in the soil receiving the latter.

The investigations show that the nitrogenous matter of manure is more nitrifiable than that of the soil, since about a hundredth of the latter and a seventh to a fourth of the former are nitrified during a year.

Nitric nitrogen contained in drainage waters during different seasons of the year.—The variation in nitrification at different seasons of the year is a matter of prime importance. The nitrates formed during spring aid the early growth of plants; those formed in summer, while they may not be of use to cereals, are utilized by beets and other root crops, etc.; while those formed in autumn and winter are lost for the most part. The following table shows the amounts in kilograms per hectare of nitrates found in drainage waters at different seasons of the year.

Nitrogen of manures nitrified during different seasons.

Grignon	manured	78.88	39.84	58.84	21.30	198.86
	without fertilizer	36.42	15.84	47.00	16.69	115.95
	Difference	42.46	23.00	11.84	4.61	82.91
Wardrecques	manured	48.48	20.46	42.10	19.44	130.48
	without fertilizer	17.10	13 44	27.66	15.60	73.80
	Difference	31 38	7.02	14.44	3.84	56.68
Marmilhat	manured	44.52	22.92	34.20	19.92	121 56
	without fertilizer	15.84	16 80	17.28	12.14	62.06
	Difference	28.68	6.12	16.92	7.78	59 50
Palbost	manured	36.96	15.96	36.42	17.10	106.44
	without fertilizer	13.08	18.18	21.04	11.95	61.02
	Difference	23.88	−2.22	15.38	6.16	45.02

The loss of nitrates was greatest in autumn during 1891. A comparison of figures for three years shows the same average result, although in 1890 the greatest loss occurred in summer. Nitrification has not been active in spring and winter. The need of applying nitrate of soda in the spring is suggested by the fact that nitrification is retarded and the supply of nitrate in the soil is small at that season. The formation of nitrates is rapid in summer, but the rainfall is small and consequently the total loss of nitrogen is not very large. It is during the abundant rain of autumn that the nitrates are rapidly washed out of the soil.

On an average one fifth of the nitrogen of manure is nitrified during the year of application and either utilized or lost. Of the total amount 10 per cent is found in the drainage water in spring, about 5 per cent in autumn, and only 3 per cent in summer.

The author's summary of results is as follows:

(1) The ratio of rainfall to drainage on fallow soils is very near unity in winter and autumn, increases in the spring, and is largest in

summer. During the year (March, 1891, to March, 1892) the amount of drainage obtained was a little larger than one half of the rainfall.

(2) The ratio of rainfall to drainage varies widely on different soils. A soil which had been improved by drainage nevertheless allowed the water to percolate readily, while another, which suffered more from dryness than excessive moisture, retained the water well. The first, moreover, rested on an impermeable subsoil, the second on a very permeable white chalk. It would appear therefore that it is an error to conclude that the nature of the subsoil more than the composition of the soil itself determines the utility of drainage.

(3) Farm manure in no case exercised a perceptible influence on the flow of drainage water.

(4) Soils under the same conditions of temperature and moisture yielded in the drainage water quantities of nitrogen almost twice as large in one case as in the other.

(5) A soil which during one year of the experiment gave a large quantity of nitric nitrogen in the drainage water, in the following year gave much less, while the soil in which nitrification had been moderate the first year, gave the second year a quantity equal to or even larger than that yielded the first. It is not true therefore that the soils which contain the most nitrifiable nitrogenous matter are those which are the most readily exhausted.

(6) During the year 1891-'92 the amount of nitric nitrogen in the drainage water averaged 31.7 kg. per cubic meter, the proportion rising to 51.7 kg. for soil in a good state of fertility and falling as low as 17.6 kg.

(7) On applying to the soil a liberal amount of farm manure it was found that the amount of nitric nitrogen in the drainage water was invariably increased, but not uniformly. This supports the view that the nature of the nitrifiable material does not exert a decisive influence on the amount of nitrogen carried off by the drainage water. During one year a fourth to a seventh of the nitrogen of the manure passed off in the drainage water of fallow soil.

(8) The drainage waters of unmanured soils do not carry off equal quantities of nitric nitrogen during all of the seasons. In autumn the loss is considerable and in the spring it is least. The quantity of nitrogen nitrified during this period is nevertheless larger than during summer or winter.

(9) The abundance of nitrates in the drainage waters in autumn, amounting on an average for three years (1889-'90, 1890-'91, and 1891-'92), to 40.6 kg., corresponding to 250 kg. of nitrate of soda, indicates the necessity of having the soil covered with a crop (*cultures dérobées*) in autumn.

(10) The small amount of nitrates in the drainage of spring, which has amounted on the average for three years on unfertilized soils to 17.03 kg. of nitric nitrogen, suggests the wisdom of applying nitrate of soda at that season.

(11) On manured soil the water is rich in nitrates in the spring. It is very probable that this production of nitrates following an application of manure is due to the transformation of ammonia.

(12) During the year 1891–'92, of 100 parts of nitrogen of the manure applied to the different soils, 10 were nitrified in the spring, 3 in summer, nearly 5 in autumn, and about 2 in winter, forming altogether 20 per cent or one fifth of the nitrogen of the manure.

(13) It is the first rains of autumn which furnish drainage water richest in nitrates. At this time it contains an average of 79 grams per cubic meter of nitric nitrogen. In manured soil this amount rises to 130 grams. In winter the water is poorest; it contains in December–January not more than 10 grams per cubic meter, *i. e.*, 1 part of nitrogen per 100,000 parts of water.

The results obtained by a study of the drainage water from cultivated soils will be given in the next memoir.—W. H. B.

Distribution and form of iron in barley, P. PETIT (*Compt. rend.*, *115 (1892), No. 4, pp. 246–248*).—For determining the state of combination of iron in barley grain, 100 grams of finely ground dry barley was treated with boiling absolute alcohol, containing 1 per cent hydrochloric acid, for six hours in a Soxhlet extraction apparatus. There was obtained from 100 grams of dry barley—

	Mg.
Iron extracted by acidified alcohol	1.10
Iron in the residue	19.28
Total	20.38

The determination of iron directly in 100 grams of the dry barley gave a total of 20.3 mg. This showed that almost the whole of the iron of the barley is in the state of nuclein. To determine the distribution of the iron in the different parts of the grain the barley was treated with a boiling 5 per cent solution of soda for two or three minutes. This treatment allowed the grain to be readily separated into three parts, embryos, integuments, and albumen. Each of these was dried and burned and the iron determined in the residue. The results were as follows:

	Weight.	Iron.	
	Grams.	*Mg.*	*Per cent.*
Dried embryos	4.250	4.96	0.110
Integuments	8.471	8.26	0.097
Albumen	65.127	1.66	0.002
Soda solution	....	1.10	....

As shown above, the iron is contained almost exclusively in the integuments and embryos. Finally, the author endeavored to determine whether germination produced any change in the form and distribution of the iron. For this purpose barley was placed in the Nobbe germinator.

When the plumules and radicles appeared they were removed, dried, and extracted with acidulated alcohol, with the following results: Weight of embryos with radicles 4.97 grams, iron in the alcoholic extract 0.2 mg., iron in the alcoholic residue 2.2 mg.

The quantity of iron not in the form of nuclein varied but little, but the proportion of the iron diminished. This indicates that the embryos possess their own reserve supply of iron and that it is not derived from the albumen and integuments.—W. H. B.

The culture and treatment of tobacco, J. NESSLER (*Landw. Vers. Stat., 40, pp. 395–438*).—Since the publication by the author in 1867 of his book on tobacco and tobacco culture, many new studies have been made, and these, together with the results of previous experience, are treated in this article under the following heads: (1) Demands of the trade, especially with reference to burning qualities; (2) what amount of chlorine is allowable and what amount of potash essential to the desired burning quality; (3) effect of soil on the burning quality; (4) amounts of chlorine and potash removed from the soil by different crops and effect of previous cropping on the burning quality of tobacco; (5) amounts of potash and chlorine furnished the soil in different manures; (6) effect of manuring on burning quality; (7) effect of previous cropping and manuring on the properties of tobacco other than that of burning; (8) injurious and beneficial methods of cropping and manuring tobacco; and (9) practical conclusions.

The various properties of the tobacco leaf, burning qualities, size, weight, delicate structure, elasticity, color, and fermentative properties, are all more or less affected by the variety of tobacco, the soil, time, and manner of manuring, manner of setting, treatment of the plants in the field, climate, and time of harvesting. The properties of tobacco may also be very materially affected by the manner of curing, the condition of the weather during drying, time of hanging, the way in which it is kept until fermentation, and the fermentation itself. The fact that so many factors play a part in determining the quality of tobacco makes this subject an especially difficult one to study. Further than this the author points out that it is more difficult to follow the progress of tobacco than that of most other plants. The intermediate stages between setting and curing offer little chance for study of the development of the qualities of the plant, as is the case with sugar beets, fruits, etc.

Limits to chlorine and potash in tobacco.—To secure the desired burning quality, the amount of chlorine must not rise above a maximum nor the amount of potash sink below a minimum. In 1889 studies were made of 46 samples of tobacco grown in Baden on different soils and with different manuring. From these studies the conclusion was that tobacco continued to glow longer, *i. e.*, burned better, the more potash and less chlorine (sodium chloride) it contained. The higher the potash content the more chlorine may be present without materially

affecting the burning quality; that is, a high potash content in a measure offsets the effects of the chlorine. It is stated that in general tobacco will be of inferior burning quality which contains more than 0.4 per cent chlorine and less than 2.5 per cent potash.

Effect of soil on burning quality of tobacco.—As a result of the studies referred to above it was found that while tobacco from sandy soils contained on an average only 0.29 per cent of chlorine, that from heavy soils contained 0.92 per cent of chlorine, and that tobacco from light soils averaged 2.8 per cent potash, while that from heavy soils averaged 2.4 per cent. The indications are that to secure the best burning qualities tobacco should be grown on light or medium soils, but not on heavy clay soils.

Effect of manuring on burning qualities.—It was mentioned above that to be of good burning quality tobacco should not contain more than 0.4 per cent chlorine to 2.5 per cent potash, that is, six times as much potash as chlorine; consequently fertilizers for tobacco should contain at least six parts of potash for every part of chlorine that is at the disposal of the plant. The closer the relation between potash and chlorine in a fertilizing material the less it is adapted for tobacco. Of a large number of fertilizing materials examined night soil was found to be the least adapted for tobacco, containing 100 parts of chlorine to 40 parts of potash. Kainit, with 100 parts of chlorine to 50 parts of potash, was little better. The results of analysis of a large number of samples of liquid manure showed the relation between potash and chlorine to vary widely with the feeding stuffs from which it was made and with the potash and chlorine content of the soil on which these feeding stuffs were grown. The parts of potash per 100 parts of chlorine ranged from 182 to 917. It will be pointed out later that while under certain conditions any liquid manure may be disadvantageous to the quality of tobacco, the assumption that liquid manure is disadvantageous in all cases is incorrect. In barnyard manure the relation varies much the same as in liquid manure, depending upon the kinds of food eaten and the soil on which they were grown. The manure from feeding materials rich in potash, as beets or potatoes, is far better adapted to tobacco than that made from crops containing a lower percentage of potash. In the examination of a large number of samples of barnyard manure the potash was found to range from 436 to 1,450 parts per 100 parts of chlorine. In general the manure from cattle is better adapted for tobacco than that from horses, and manure from sheep and swine should not be used in growing smoking tobacco. Sugar beet residue contains a small amount of chlorine in proportion to the potash (100 to 1,041), but a trial of this material on tobacco failed to give any perceptible result the year it was applied. A large number of experiments have been made by the author with potassium nitrate, potassium sulphate, potassium muriate, purified potash magnesium sulphate, gypsum, and common salt. The chlorine compounds always injured the

burning qualities noticeably; and the potassium sulphate and potassium nitrate often improved this quality, though not always, the failure being due, it is believed, to the potash not being sufficiently distributed through the soil, or where heavy applications were made, to the formation of too concentrated solutions.

The tobacco plant produces material very rapidly and requires a constant supply of plant food from the soil, but on the other hand it is exceedingly sensitive to concentrated solutions. The latter are unfavorable to a healthy growth. It is an important matter therefore that the fertilizer, especially the potash, be thoroughly mixed with the soil to a depth to which the roots extend. This may be accomplished in a measure by applying the fertilizer late in the fall or better by applying it a year previous to the growth of tobacco and in the meantime growing crops which take little potash from the soil. Potassium sulphate and purified potash-magnesium sulphate may be applied for tobacco late in the fall as well as in the spring. Potassium nitrate should only be used in the spring and in small quantities, otherwise there is danger from too concentrated solutions. Trials by the author of using potassium carbonate in the form of wood ashes gave a tobacco of good burning quality, but when large quantities were used the development of the plant was hindered, probably, the author thinks, by the alkaline reaction. On soils containing much humus this alkaline reaction will be neutralized. Soils poor in humus may be injured for tobacco by application of potassium carbonate in the fall, and precautions should be taken in the use of this material for fall manuring. Besides this the price at present is too high for its economical use in practice. In a single trial with potassium phosphate this material aided the development of the plant, but did not improve the burning qualities.

Previous culture of land for tobacco.—The qualities of the soil and the manuring are largely responsible for the early or late ripening and the regular or irregular ripening of tobacco. Tobacco plants ripen later on soils rich in organic matter or those on which clover or lucern have been previously grown, except in the case of sandy soils, where the organic matter decomposes rapidly, so that the clover has little or no disadvantageous effect on the ripening of tobacco following it. Heavy applications of nitrogenous manures retard ripening. Tobacco richly manured with liquid manure, night soil, barnyard manure, or nitrate of soda ripens late. If the plants are set late on fields so manured or those rich in humus the leaves may not have time to ripen, and a greenish leaf will result, which in burning gives an unpleasant odor. Especially disadvantageous is the practice of applying liquid manure to growing tobacco during the summer. This tends to the production of large leaves, but the leaves are also thick and often fail to ripen. The desired brown color is not obtained when barnyard manure is replaced in a too high degree by saltpeter. In one case oil-cake meal had a much better effect than saltpeter, but oil-cake meal should be

used only on loose, sandy soils and not on heavy soils. The falling off in burning qualities sometimes noticed where tobacco is grown continuously for a succession of years, the author believes is often due to the depletion of the soil in available potash and the increase in chlorine. The larger the amount of products rich in potash and poor in chlorine which are sold off from the farm, and the poorer the barnyard manure is in potash and the richer in chlorine, the less adapted will the conditions become for growing tobacco.

In the investigation of tobacco grown on different soils, as mentioned above, it was found that the product from sandy soils contained quite as much potash but much less chlorine than that from heavy soils. In experiments in 1884 and 1885 in using different manures for the preparatory crop, no effect was noticed from the chlorine contained in the fertilizers applied the year previous to tobacco. This will be the case on sandy soils through which the chlorine is easily leached. Corn, beets, lucern, and red clover are among those crops which remove the largest amounts of potash from the soil. If these materials are fed on the farm and the manure carefully collected and preserved, no considerable depletion of the soil in potash should result, for 1,000 pounds of animal product, live weight, contains only from 1.5 to 2.4 pounds of potash, and 1,000 liters of milk contains about 3.7 pounds of potash, together with from 1 to 3 pounds of chlorine, and in some cases much more. In regions where tobacco is grown, however, it is advisable to grow grain, rape, and hemp for the market rather than potatoes or roots, and to cultivate large amounts of fodder plants to be converted into animal products. As far as possible, corn, beets, lucern, and clover should be grown on fields not used for tobacco, and the manure from feeding beet tops should not be applied to tobacco, but rather to other fields, while that from feeding potatoes and roots is well adapted for tobacco.

Practical conclusions.—The money value of German tobacco depends especially upon (1) its burning qualities, (2) the fineness of the leaf and the ribs, (3) the right stage of ripeness and even ripening, and (4) proper curing. Under otherwise corresponding conditions, tobacco glows longer, *i. e.*, its burning quality is better, the more potash and the less chlorine it contains. In order to obtain leaves rich in potash and poor in chlorine the following points should be observed:

(1) The growth of fodder plants and the raising of animals should be followed as far as possible. Crops for marketing other than tobacco should consist, where the conditions are favorable, of only hemp, grain, and rape. In animal products, milk, hemp, grain (seeds), and rape, only small quantities of potash are sold. Animal products often contain more chlorine than potash.

(2) In regions where, on account of the previous manuring, the soil and the plants grown thereon contain much common salt, no salt should be given to the cattle.

(3) As preparatory crops for tobacco, the market crops mentioned

above and tobacco itself are best. Where sufficient potash can be applied, turnips or scarlet clover may also be grown.

(4) Fodder corn, beets, lucern, and red clover are inapplicable for soils to be used for tobacco and should only precede tobacco when large applications of potash salts in forms desirable for tobacco are made.

(5) From the sale of potatoes, sugar beets, and chicory, which contain ten to twenty times as much potash as chlorine, the farm is depleted of potash, and where leaves and tops are fed much chlorine is restored to the soil. Where roots and potatoes are sold from farms used for tobacco-growing, the potash should be replaced in a form which is desirable for tobacco.

(6) Manure from feeding the tops of sugar beets, turnips, and chicory should be applied to fields not used for tobacco.

(7) In tobacco regions potash manures containing common salt, as kainit, carnalite, etc., should not be applied either to tobacco or to other plants, as otherwise feeding stuffs are grown which are rich in chlorine and consequently produce a manure rich in this element. On heavy soils from 1,000 to 1,400 kg. of wood ashes or 200 kg. of potassium sulphate, and on light, sandy soils 200 kg. of concentrated muriate of potash per acre are to be used, but the latter material is never to be applied to tobacco itself.

(8) Night soil should only be applied to sandy soils and on these never directly to tobacco.

(9) Tobacco for smoking purposes should be grown on light, sandy, or medium soil, but never on heavy soil.

(10) The best manure for tobacco is good cow manure, which is better than horse manure. Manure from sheep and swine is not adapted for tobacco. The best manure is obtained from feeding potatoes, beets, and turnips without the tops.

(11) The manures should be applied part late in the fall and part in the spring and should be thoroughly mixed with the soil by repeated plowing.

(12) Barnyard manure can not be replaced by commercial fertilizers, but its action may be improved by the addition of commercial fertilizers.

(13) In regions where the soil, and consequently the food and the manure produced, contains little salt, and where little or no salt is fed, the liquid manure may be regarded as a good manure for tobacco. It should be applied, however, during the winter or early spring, before the first plowing. During the growth of the plant no liquid manure should be applied.

(14) In regions where the soil, fodder, and manure are rich in chlorine, and where tobacco is often deficient in burning quality, the fields used for tobacco should not be manured with liquid manure.

(15) From 900 to 1,250 pounds of wood ashes or 350 pounds of potas-

sium sulphate per acre may be applied to tobacco, the application being made to deep soils late in the fall or to shallower soils before the first plowing. In the spring, before setting the plants, 135 to 180 pounds of nitrate of soda may be applied where the land is not heavily manured.

(16) In rainy seasons, when the plants lose their dark green color and fail to grow well, 90 to 135 pounds of nitrate of soda per acre may be applied while the plants are small.

Delicacy of leaf and ribs.—The more regularly the plants grow with not too strong and not too weak manuring the better will be the quality of the tobacco. A thorough loosening of the soil and careful manuring and culture of the plants especially have a marked effect on the delicacy of the leaf. There is hardly another plant which requires more care and skillful treatment on the part of the farmer from time of setting until the sale of the product than tobacco designed for cigar-making. Thick leaves with large ribs are produced (1) when the seeds are from poor plants; (2) when the soil is too heavy; (3) when the soil is too compact; (4) when too heavily manured, especially when night soil or liquid manure are used. Too heavy manuring tends to the production of spongy tobacco. Tobacco requires heavy manuring, but when strong solutions of plant food are formed in the soil, as for instance when night soil or liquid manure, or large quantities of wood ashes or commercial fertilizers are used, the regular growth is interfered with and a rank product of irregular quality results. (5) When the subsoil does not contain sufficient plant food. If the upper layers of the soil are well manured and the subsoil contains insufficient plant food a luxuriant growth takes place as long as the upper layers contain sufficient moisture, but during a dry spell the growth of the plant is repressed because the roots can not find sufficient plant food. If a part of the manure is plowed in late in the fall it is more easily distributed through the soil and favors a more regular growth of the plant even in case of drouth. If tobacco is grown on the same field year after year the quality will be better, because the soil will be made more porous and the manure applied in the previous years, so far as it is not taken up by the plant, is evenly distributed through the soil. (6) Where the plants are topped too much or too late. The number of leaves which can be left to grow should be carefully considered. With heavy manuring thick-leaved and often poorly burning tobacco, which by burning gives an unpleasant odor, is produced when only seven or eight leaves are allowed to grow; in such cases thirteen or fourteen leaves are not too many. When the manuring is not so heavy the plants may be topped lower down, but in that case it must be done early, so that by the removal of a number of leaves the growth of the tobacco is not disturbed. (7) When too many leaves are removed. By proper treatment valuable tobacco can be secured from the lower leaves, which ripen first and in the first cutting may be removed before the final cutting, but if too many leaves are removed the growth of the plant is disturbed the same as in topping, and

the leaves become thick and spongy. (8) As a result of heavy winds. In general better tobacco is secured in sheltered places than in exposed fields.

The proper and regular ripening of tobacco.—Unripe tobacco is secured, (1) when the plants are set too late—it is impossible to give a general rule for time of setting which shall apply to all seasons, but in general the early-set tobacco is in greater demand and commands a higher price than late set; (2) when too large quantities of nitrogenous manures are applied, as barnyard manure, liquid manure, Chile saltpeter, etc.; (3) when the soil contains large quantities of organic matter. Tobacco grown on soils rich in humus or moor soils, and following clover on heavy soils, is likely to remain green. On light soil a good quality may be raised after clover, because the air enters the soil and rapidly decomposes the organic matter left behind by the clover.

Irregularities in ripeness result, (1) when the plants set out are not uniform, (2) as a result of uneven distribution of the manure or where the plants receive a dressing of liquid or easily soluble manures after they are partially grown. In the spring, before setting the plants, 180 to 220 pounds of nitrate of soda per acre may be applied, and if heavy rains follow which may leach off the nitrate, 90 to 135 pounds of nitrate of soda per acre may be applied while the plants are still small.

The manner of drying the leaves is of the greatest importance in determining the quality of late tobacco. The author describes the method of cutting slits in the ribs to aid the drying, which practice has been tried by him. This process very materially aids the drying of the tobacco and very materially diminishes the danger from mildew and decay. It is very generally followed in Holland, and the author recommends its trial. The leaves are strung on wires which pass through the slit, and are hung where the draft is not too strong, otherwise the drying progresses too rapidly. If the tobacco is hung up too soon it mildews; if thin, fine tobacco is allowed to hang too long it becomes colored and the elasticity is injured, it diminishes in weight, and does not ferment as well.—E. W. A.

On the chemical composition of apples and pears, P. KULISCH (*Landw. Jahrb., 21 (1892), pp. 427-444*).—These studies were made at the institute for fruit and wine culture at Geisenheim, Germany, and were with special reference to the use of apples and pears for making fruit wines. They were in continuation of studies reported in the same journal in 1890 (p. 109). A considerable part of the present paper is occupied with a technical discussion of the preparation of fruit wines. Only that part relating to the composition and ripening of the fruits will be considered here.

Analyses are reported of the expressed juices of a large number of apples and pears grown under varying conditions of soil, climate, etc. The analyses show that all of the 23 varieties of apples examined contained cane sugar when ripe (tree ripe), the amount in 100 c. c. of

juice varying from 0.07 to 6.21 grams. For each 100 parts of invert sugar present the cane sugar ranged from 8.5 to 96.9 parts, forming therefore nearly one half of the total sugar present, in some instances. Varieties which from a pomological point of view were very similar, showed no similarity in this respect. Observations on the process of ripening in the apple have shown that cane sugar can continue to be formed from the starch after the fruit is taken from the tree, and that during the winter the cane sugar is gradually but finally almost entirely changed to directly-reducing sugar. The cane sugar continues to increase as long as the amount formed from starch is in excess of that inverted; as soon as this condition is reversed the cane sugar content decreases, until, as stated above, the fruit contains invert sugar exclusively. According to the author's previous observations, the maximum sugar content of the fruit (both cane sugar and total) is reached earlier the earlier in the season the apple ripens, being as late as November for the late winter varieties. This is due largely to the late varieties containing a larger amount of starch at time of picking, which is gradually transformed into sugar in keeping. The early varieties, on the contrary, contain little or no starch at time of picking and do not keep as long as the later varieties.

Besides the variety, the character of the season, soil, etc., the age and the form of the tree are said to affect the composition of the fruit. Small young trees produce relatively a very large amount of fruit. It is well known that the size of the fruit is affected by the number borne; and it is generally conceded that fruit which has been nourished by an abundant and healthy leaf surface is sweeter, of better taste in general, and keeps better than where the reverse condition prevails. In this connection the following observations are of interest:

Pears grown under different conditions.

Variety.	Shape of tree.	Number of pears on tree.	Total weight of fruit.	Average weight of one pear.	100 grams of pulp contained—	
					Sugar.	Acid.*
			Grams.	*Grams.*	*Grams.*	*Grams.*
Clairgeau Butter pear	Double cordon	2	629	314.5	7.71	
		20	4,340	217.0	6.96	
Regentin	Serpentine cordon	3	406	135.3	10.13	0.1
		5	4,294	85.9	9.13	0.043

* Calculated as malic acid.

In the case of each variety, the pears were largest where the number was smallest, and in one instance the number was so large that the fruit was not fully developed. Tests of the keeping qualities of a large number of varieties showed that within any given variety the fruit from the tree bearing the largest yield invariably ripened first. The larger pears were more juicy and softer and of superior aroma. The difference in sugar content of fruit from greater and less productive trees was not as great as would be expected.

The observations indicate that the growing fruit has a strong attraction for the carbohydrates formed in the leaves, and that although the sugar content was not materially affected by the size of the yield, owing to the increased demand for the larger crop, the carbohydrates were withheld or possibly withdrawn from other organs of the plant. Of the Clairgeau Butter variety one tree produced 600 and the other 995 grams of fruit per 100 leaves.

The conclusion is that the year following a large crop the plant has not the vitality to throw out a large number of buds, and, as is commonly seen, the yield is only medium or small. This accounts for the periodical variation in yield. Analyses of apples grown on differently shaped trees are given as follows:

Analyses of apples.

Variety.	Shape of tree.	Average weight of one apple.	100 grams of juice contained—			
			Sugar before inversion.	Total sugar after inversion.	Cane sugar.	Acid (calculated as malic).
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Ananas-Reinette	Palmate	27.5	6.96	7.77	0.77	0.29
		50.8	6.63	8.91	2.17	0.42
		70.3	6.34	9.83	3.31	0.47
		101.3	6.35	10.04	3.51	0.50
Ananas-Reinette	Horizontal cordon	79.4	7.47	11.12	3.46	0.57
		172.8	6.78	11.18	4.18	0.61
Champagner-Reinette	do	57.1	7.24	8.13	0.85	0.57
		98.4	7.27	8.93	1.58	0.62
Lamb Abbey-Parmäne	Pyramidal	63.8	8.90	13.15	4.05	0.24
		107.7	7.88	13.40	5.24	0.22

It is seen that in the case of the same tree, the larger the apple the higher the sugar content, and the same rule holds with reference to the acid content in most cases. The results confirm the statement of others, that the acid and the sugar content stand in no relation to each other, and are in opposition to the theory that in the ripening of fruit the sugar formation and the acid decrease run parallel. The fact that larger apples contained the larger proportion of cane sugar, both with respect to the total bulk and to the total sugar, in spite of the higher acid content, is a strong indication that the relation of invert sugar to cane sugar depends more largely upon other factors than on the acid content of the fruit.

At the conclusion of the article analyses are given of the juice of peaches, prunes, and plums.—E. W. A.

The danger from corn cockle in flour and breadstuffs, NEVINNY (*Zeitsch. Nahrungsmtl. Untersuch. und Hyg., 1891, p. 276*).—Of six hundred and seven samples of flour recently examined by the author, 106 were found to contain impurities, and 19 per cent of these contained corn-cockle seed, the amount of the latter ranging from 0.2 to 2 per cent. A person eating 1,200 grams of bread made from flour containing only 0.5 per cent of cockle seed would consume 6 grams of cockle seed,

an amount which the author believes beyond doubt to be poisonous in its effect. While it is conceded that a part of the poisonous principle, sapotoxin, is decomposed in baking, this applies to only a relatively small part. The author therefore believes that the grinding or sale of grain or meal containing cockle seed should be forbidden.—E. W. A.

Earthworms and tuberculosis, LORTET and DESPEIGNES (*Compt. rend., 115 (1892), pp. 66, 67*).—In a previous paper the author called attention to the fact that earthworms kept the tuberculosis bacilli alive in their bodies for many months and could then return to the surface of the soil the germs infiltrated into their tissues. On further investigation of this question the author found that these worms feeding in a soil contaminated with tuberculosis, returned to the surface of the soil in their excrement the germs of the disease unimpaired in virulence. This agrees with the observations of Pasteur regarding charbon bacteria.—W. H. B.

Behavior of sterilized milk toward digestive fluids, ELLENBERGER and HOFMEISTER (*Molk. Ztg., 1892, No. 6; abs. in Vierteljahressch. Chem. Nahrungs- u. Genussmtl., 1892, p. 9*).—The casein of milk is said to be very much changed by sterilizing. There is no formation of cheese in the stomach when sterilized milk is eaten, as is the case with fresh milk, and the action of the acids of the stomach and the lactic acid ferment on the casein of sterilized milk is said to be very incomplete. The precipitated mass is fine, floccular, light, and not sticky. The sterilized milk therefore remains in the stomach in a more or less liquid condition, and may pass easily and too soon from the stomach into the intestines. In the intestines also it does not coagulate like fresh milk, and may therefore pass through these too rapidly, so that there is danger that undigested milk may pass through the stomach and intestines. The authors believe that there is need for further digestion experiments before conclusions as to the relative digestibility of sterilized and raw milk can be reached.—E. W. A.

Is milk acid or alkaline? L. VAUDIN (*Bul. Soc. Chim. de Paris, 7–8 (1892), ser. 3, No. 14, pp. 483–492*).—The author's conclusions from extended observations are as follows: (1) The milk of mammals possesses an acid reaction at the moment when it is drawn from the mammary glands; (2) the acidity of the normal milk of animals of the same species varies but little; (3) all the influences which disturb lactic secretion (gestation and parturition, feeding, etc.) cause a change of acidity; (4) the acid reaction of milk is principally due to the protein substances which it contains; (5) the variations in acidity which occur during the period of lactation depend upon simultaneous changes in the nature and relative proportions of the various protein substances and mineral elements of the milk.—W. H. B.

Transmission of alcohol to milk, KLINGEMANN (*Molk. Ztg., 1892, No. 5; abs. in Vierteljahressch. Chem. Nahrungs- u. Genussmtl., 1892, p. 7*).—The author made experiments with goats to observe whether where alcohol was consumed it was transmitted to the milk. The doses of

alcohol ranging from 25 to 200 c. c., strongly diluted with waters, were given at night, and the milk of the following day tested for alcohol. Following doses of 25 and 50 c. c. no alcohol was perceptible in the milk. When the amount was increased to 100 c. c. the next morning's milk contained a trace of alcohol (0.15 to 0.3 per cent), but the night's milk was alcohol-free. With a dose of 200 c. c. the milk was reduced in yield to about one third, and contained 0.35 c. c. alcohol in the morning and about 0.1 c. c. at night. The day following this the milk was again alcohol-free. Taken in moderate amounts, therefore, there was no transmission of alcohol to the milk, and in large doses only a very small amount appeared in the milk. No alcohol was found in human milk after the consumption of minute quantities, but with increased consumption small amounts were detected. The behavior of the fusel oil in this connection remains an open question.—E. W. A.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

Elementary analysis of nitrogenous substances (*Zur Elementaranalyse stickstoffhaltiger Körper*). CLEMENS and GEHRENBECK.—*Ber. deut. chem. Ges., 22, p. 1694; abs. in Zeitsch. analyt. Chem., 31, Heft 4, pp. 462–464.*

The determination of nitrogen by the E. Boyer method (*Ueber die Bestimmungsmethode des Stickstoffs nach E. Boyer*), K. ARNOLD and K. WEDEMEYER.—*Zeitsch. analyt. Chem., 31, pp. 388, 389; abs. in Chem. Centralbl., 1892, II, No. 15, p. 671.*

An easy method for determining nitrogen in nitrates (*Eine leicht ausführbare Stickstoffbestimmung in Nitraten*), K. ARNOLD and K. WEDEMEYER.—*Zeitsch. analyt. Chem., 31, pp. 389–392; abs. in Chem. Centralbl., 1892, II, No. 15, p. 672.*

Precipitation of phosphates and arsenates by molybdate of ammonia (*Précipitation des phosphates et des arsenates par le molybdate d'ammoniaque*), B. MOREAU.—*Jour. Pharm. et Chim., 26 (1892), ser. 5, No. 4, pp. 157–163.*

The reliability of the estimation of phosphoric acid as magnesium pyrophosphate, especially by the molybdic method (*Ueber die Zuverlässigkeit der Phosphorsäurebestimmung als Magnesiumpyrophosphat, insbesondere nach der Molybdänmethode*), H. NEUBAUER.—*Zeitsch. anorgan. Chem., 1892, p. 45; abs. in Chem. Ztg., 1892, Repert., p. 276.*

Determination of aluminic phosphate by precipitation with ammonia and with acetates of alkalis (*Ueber die Bestimmung von Thonerdephosphat durch Fällung aus seinen Lösungen durch Ammon und durch Alkali-Acetate*), C. GLASER.—*Zeitsch. analyt, Chem., 31, Heft 4, pp. 383–388.*

Determination of oxide of iron and alumina in mineral phosphates, G. MARIANA and E. TASSELLI.—*Staz. speriment. agric. ital., 23, pp. 31–37; abs. in Chem. Centralbl., 1892, II, No. 15, p. 673.*

Determination of the carbon dioxide in the air of buildings, A. H. GILL.—*Analyst, 1892, pp. 184–186.*

A product of oxidation of starch (*Sur un produit d'oxydation de l'amidon*), P. PETIT.—*Jour. Pharm. et Chim., 26 (1892), ser. 5, No. 6, pp. 278–280.*

Determination of starch and the action of dilute acids on cellulose, GUICHARD.—*Bul. Soc. Chim. de Paris, 7–8 (1892), ser. 3, pp. 554–560; abs. in Chem. Centralbl., 1892, II, No. 12, pp. 558, 559.*

The fixation of iodine by starch (*De la fixation de l'iode par amidon*), G. ROUVIER.—*Jour. Pharm. et Chim., 26 (1892), ser. 5, No. 6, p. 278.*

The characterization of sugars (*Zur Charakterisirung von Zuckerarten*), O. LOEW.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 131–135.*

The detection and determination of sugar in urine (*Ueber den Nachweis und die Bestimmung von Zucker im Harn*), E. LAVES.—*Pharm. Post, 1892, p. 739; abs. in Pharm. Centralh., 33, pp. 447, 448, and Chem. Centralbl., 1892, II, No. 12, p. 557.*

Pentaglucoses in urine (*Pentaglykosen im Harn*), E. SALKOWSKI.— *Centralbl. med. Wissensch., 1892, pp. 593–595; abs. in Chem. Centralbl., 1892, II, No. 11, p. 483.*

Pentaglucoses in human urine (*Verhalten der Pentaglykosen im menschlichen Harn*), W. EBSTEIN.—*Virchow's Arch., 129, pp. 401–412; abs. in Chem. Centralbl., 1892, II, No. 15, p. 655.*

Pentaglucoses in the human body (*Pentaglykosen im menschlichen Organismus*), W. EBSTEIN.—*Centralbl. med. Wissensch., 1892, pp. 577, 578; abs. in Chem. Centralbl., 1892, II, No. 11, p. 483.*

Chromic acid as a reagent for albumen in urine (*Chromsäure als Reagens auf Eiweiss und Gallenfarbstoff im Harn*), O. ROSENBACH.—*Deut. med. Wochensch., 1892, No. 17; abs. in Chem. Centralbl., 1892, II, No. 12, p. 557.*

Separation of albuminoids by metaphosphoric acid in the determination of lactose in milk, G. DENIGÈS.—*Bul. Soc. Chim. de Paris 7–8 (1892), ser. 3, pp. 493–499; abs. in Chem. Centralbl., 1892, II, No. 12, p. 559.*

Gums and pectic substances, and a new organized ferment of cherry gum (*Sur les matières gommeuses et les matières pectiques; nouveau ferment organisé de la gomme cerisier*), F. GARROS.—*Bul. Soc. Chim. de Paris, 7–8 (1892), ser. 3, Nos. 15, 16, pp. 625–627.*

Determination of stachyose in the root tubers of Stachys tuberifera (*Bestimmung des Stachyose-Gehalts der Wurzelknoller von Stachys tuberifera*), A. VON PLANTA and E. SCHULZE.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 123–129.*

On the determination of tannin by the Gantter method (*Gerbstoffbestimmungen nach dem Gantterschen Verfahren*), A. KLINGER and A. BUJARD.—*Zeitsch. angew. Chem., 1891, p. 513; abs. in Zeitsch. analyt. Chem., 31, Heft 4, pp. 468, 469.*

Separation of malic acid from succinic, citric, and tartaric acids (*Zur Trennung der Aepfelsäure von Bernsteinsäure, Citronsäure, und Weinsäure*), C. MICKO.—*Zeitsch. allgem. oesterr. Apotheker-Ver., 30, p. 151; abs. in Zeitsch. analyt. Chem., 31, Heft 4, pp. 465–468.*

On the determination of oleic acid, O. HEHNER.—*Analyst, 1892, pp. 181–183.*

Analysis of honey by Hänle's method (*Die chemische Analyse des Honigs nach Hänle's Methode*).—*Zeitsch. Nahrungsmitteluntersuch. und Hyg., 6, pp. 271–279; abs. in Chem. Centralbl., 1892, II, No. 10, p. 428.*

On the determination of water and of free fatty matter in soap, J. A. WILSON.—*Chem. News, 66 (1892), p. 200.*

On the oleofractometer, A. J. ZUNE.—*Rev. internat. des falsif., 6, pp. 12, 13; abs. in Chem. Centralbl., 1892, II, No. 15, p. 671.*

A new automatic filtering apparatus (*Ein neuer selbsthätiger filtrir-Apparat*), F. A. HOFFMANN.—*Zeitsch. analyt. Chem., 31, Heft 4, pp. 413–415.*

The action of mineral filters on liquids containing substances of microbic origin (*De l' influence des filtres mineraux sur les liquides contenant des substances d'origines microbienne*), ARLOING.—*Jour. Pharm. et Chim., 26 (1892), ser. 5, No. 6, pp. 266–268.*

Neutrality (indicators), A. H. ALLEN.—*Analyst, 1892, pp. 186–192,* and pp. 215–219.

The occurrence and recognition of saponin substances in vegetable products (*Zur Kenntniss des Vorkommens und Nachweises der Saponinsubstanzen im Pflanzenkörper*), T. E. HANAUSEK.—*Chem. Ztg., 1892, No. 71, pp. 1295, 1296; and No. 72, pp. 1317, 1318.*

The effects of phosphoric acid on the formation of chlorophyll (*Influences de l'acide phosphorique sur la formation de la chlorophylle*), O. LOEW.—*Jour. Pharm. et Chim., 26 (1892), ser. 5, No. 5, pp. 212, 213.*

Oxalate of lime in the wood of trees (*Sur l'oxalate de chaux des écores d'arbres*), G. KRAUS.—*Jour. Pharm. et Chim., 26 (1892), ser. 5, No. 6, p. 280–282.*

On respiration, transpiration, and dry weight of plants grown in sunlight and in shade (*Sur la respiration, la transpiration, et le poids sec des feuilles développées au soliel et à l'ombre*), L. GÉNEAU DE LAMARLIERE.—*Compt. rend., 115 (1892), No. 16, pp. 521–523.*

On assimilation in plants of the same species grown in sunlight and in shade (*Sur l'assimilation comparée des plantes de même espèce, développées au soliel ou à l'ombre.*—L. GÉNEAU DE LAMARLIERE.—*Compt. rend., 115 (1892), No. 9, pp. 368–370.*

On the structure of the assimilating tissue of stems of inland plants (*Sur la*

structure dutissu assimilateur des tiges chez les plantes mediterranéennes), W. RUSSELL.—*Compt. rend., 115 (1892), No. 16, pp. 524, 525.*

Experimental study of the effect of soil moisture on the structure of the stem and leaves (*Etude experimentale de l'action de l'humidité du sol sur la structure de la tige et des feuilles*), A. OGER.—*Compt. rend., 115 (1892), No. 16, pp. 525–527.*

Influence of continuous and discontinuous electric light on the structure of trees (*Influence de la lumière électrique continue et discontinue sur la structure des arbres*), G. BONNIER.—*Compt. rend., 115 (1892), No. 12, pp. 447–450.*

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Action of an electric current upon the growth of seeds, J. LEICESTER.—*Chem. News, 66 (1892), p. 109.*

The dimorphism of root tubercles on the pea (*Der Dimorphismus der Wurzelknöllchen der Erbse*), B. FRANK.—*Ber. deut. bot. Ges., 10, pp. 170–178; abs. in Chem. Centralbl., 1892, II, No. 15, p. 653.*

Discussion of the above paper (*Bemerkung zu Frank's Mitteilung, etc.*), H. MÖLLER.—*Ber. deut. bot. Ges., 10, pp. 242–249; abs. in Chem. Centralbl., 1892, II, No. 15, p. 654.*

Remarks on Möller's discussion of the above paper (*Uber Möller's Bemerkungen, etc.*), B. FRANK.—*Ber. deut. bot. Ges., 10, pp. 390–395.*

On a ptomaine obtained by the culture of Micrococcus tetragenus (*Sur une ptomaine obtenue par la culture du Micrococcus tetragenus*), A. B. GRIFFITHS.—*Compt. rend., 115 (1892), No. 16, p. 418.*

Fermentation of arabinose with the Bacillus ethaceticus, P. F. FRANKLAND and J. MACGREGOR.—*Jour. Chem. Soc., Aug., 1892, pp. 737–745.*

Refutation of the theory of centripetal and ascending movement in cyclones (*Educ définitif de la théorie du mouvement centripète et ascendant dans les cyclones*), H. FAYE.—*Compt. rend., 115 (1892), No. 16, pp. 482–485.*

On the composition of sea water, F. GIBSON.—*Chem. News, 66 (1892), pp. 151, 152.*

The liming of stiff clay soils (*Ueber die Bekalkung von steifen Kleyböden*), A. F. HOLLEMAN.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 37–41.*

The diffusibility of the Leguminosæ bacteria in the soil (*Ueber die Verbreitungsfähigkeit der Leguminosen-Bakterien im Boden*), F. NOBBE, E. SCHMID, L. HILTNER, and E. HOTTER.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 137–140.*

Results from green-manuring heavy soil with white sweet clover (*Erfolge von Bokharaklee (Melilotus alba) als Gründüngung auf schwerem Boden*).—*Braunschwg. landw. Ztg., 1892, No. 38, p. 160.*

The theoretical and practical questions in manuring (*Die theoretischen und praktischen Aufgaben der Düngung*), LIEBSCHER.—*Fühling's landw. Ztg., 1892, No. 19, pp. 705–710, and No. 20, pp. 743–748.*

Meadow plants during the dry summer of 1892 (*Les prairies dans l'été sec de 1892*), A. CHATIN.—*Compt. rend., 115 (1892), No. 11, pp. 397–399.*

The sand vetch (Vicia villosa), its importance as the earliest plant for green fodder, and the best time for seeding (*Die Sandwicke, ihre Bedeutung als früheste Grünfutterpflanze und die zweckmässigste Saatzeit derselben*), J. KÜHN.—*Landw. Wochenbl. Schleswig-Holstein, 1892, No. 39, pp. 342–345, and Braunschwg. landw. Ztg., 1892, No. 38, p. 160.*

Field experimentation in Lorraine (*Das Feldversuchswesen in Lothringen*), H. GERDOLLE.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 97–122.*

The analysis of the Cavendish banana (Musa cavendishii) in relation to its value as a food, W. M. DOHERTY.—*Australasian Association for Advancement of Science, Hobart, 1892, Section B; abs. in Chem. News, 66 (1892), pp. 187, 188.*

Mildewing of animal and vegetable materials, especially tobacco (*Ueber das*

Schimmeln tierischer und pflanzlicher Stoffe, besonders des Tabaks), J. NESSLER.—*Zeitsch. landw. Ver. Hessen, 1892, pp. 25–27.*

The manufacture and the properties of linseed cake and linseed meal (*Ueber die Fabrikation und Beschaffenheit des Leinkuchens bezw. des Leinmehles*), HASELHOFF.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 55–72.*

The manufacture and adulteration of linseed cake and the detection of the latter (*Ueber Fabrikation Verunreinigungen von Leinkuchen und deren Nachweis*), F. J. VAN PESCH.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 73–93 (illustrated).*

Cake from the seed of false flax (Camelina sativa) (*Leindotter Kuchen*), F. J. VAN PESCH.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 94, 95.*

On the value of asparagin as a food nutrient (*Ueber die Bedeutung des Asparagins als Nahrungsstoff*). G. POLITIS.—*Zeitsch. Biol., 28, pp. 433–449; abs. in Chem. Centralbl., 1892, II, No. 12, p. 537.*

Effect of asparagin on the albuminoid exchange of Carnivora (*Ueber den Einfluss des Asparagins auf den Umsatz des Eiweisses beim Fleischfresser*), J. MAUTHNER.—*Zeitsch. Biol., 28, pp. 506–517; abs. in Chem. Centralbl., 1892, II, No. 12, p. 537.*

The storage of fluorine compounds in the body of animals accompanying the feeding of sodium fluoride (*Ueber die Ablagerung von Fluorverbindungen im Organismus nach Fütterung von Fluornatrium,*) J. BRANDEL and N. TAPPEINER.—*Zeitsch. Biol., 28, pp. 518–539; abs. in Chem. Centralbl., 1892, II, No. 12, pp. 537, 538.*

Recognition of yellow coloring matters in food materials, CHIAPPE.—*L'Orosi, 15, pp. 156–159; abs in Chem. Centralbl., 1892, II, No. 10, p. 427.*

Remarks on feeding experiments in general and the results of some recent experiments (*Einiges uber Fütterungsversuche im Allgemeinen und über neuere Fütterungserfolge*), HUCHO.—*Fühling's landw. Ztg., 1892, No. 20, pp. 728–735.*

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Tuberculin treatment of tuberculous Guinea pigs (*Ueber Tuberkulinbehandlung tuberkulöser Meerschweinchen*), S. KITASATO.—*Zeitsch. Hyg., 12, pp. 320-327; abs. in Chem. Centralbl., 1892, II, No. 15, p. 662.*

Is the use of tuberculin as a diagnostic in cattle to be recommended (*Ist das Tuberkulin zur Feststellung der Tuberkulose bei den Rindern zu verwenden*)? EGGELING.—*Mitt. deut. landw. Ges., 1892, No. 10, p. 101.*

The cause of the color of milk, C. A. CAMERON—*Chem. News, 66 (1892), p. 187.*

Volatile fatty acids of butter, W. JOHNSTONE.—*Chem. News, 66 (1892), pp. 188, 189.*

Determination of lactic acid in milk (*Zur Milchsäurebestimmung*).—*Milch. Ztg., 1892, No. 36, pp. 609-611.*

Difference in the nutritive effect of raw and cooked milk (*Ueber den Unterschied der Nährwirkung roher und gekochter Milch*), WASILEFF.—*Molk. Ztg., 1892, No. 7; abs. in Chem. Centralbl., 1892, II, No. 11, p. 490.*

Determination of fat in milk with the lactocrite and the new acid mixture (*Ueber die Bestimmung des Fettgehaltes der Milch vermittelst der neuen Laktokritsäure*), J. NEUMANN.—*Milch. Ztg., 1892, No. 37, pp. 625-627.*

The determination of fat in milk by the Demichel lactobutyrometer (*Ueber Milchfettbestimmung mit dem Lactobutyrometer von Demichel*),—L. GRAFFENBERGER.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 43-54.*

Note on the Reichert process for butter and other fats, J. A. WILSON.—*Chem. News, 66 (1892), pp. 199, 200.*

Older and more recent Danish experiments on the keeping quality of milk and its improvement by pasteurization (*Aeltere und neuere dänische Versuche über die Haltbarkeit der Milch und deren Vermehrung durch das Pasteurisieren*), N. J. FJORD and H. P. LUNDE.—*Abs. from Danish in Centralbl. agr. Chem., 21, Heft 9, pp. 621–628.*

Effect of pasteurization of milk on its curding with rennet (*Einfluss des Pas-*

teurisirens auf das Laben der Milch), VON FREUDENREICH.—*Schweiz. Milch. Ztg.; abs. in Fühling's landw. Ztg., 1892, No. 20, p. 759.*

Bacteriological investigations of some forms of abnormal milk and butter (*Bakteriologische Untersuchungen über einige Milch und Butterfehler*), C. O. JENSEN.—*Abs. from Danish in Centralbl. agr. Chem., 21, Heft 9, pp. 628–637.*

The acetic acid test for butter, F. JEAN.—*Industrie Laitière, 1892, No. 26, p. 205; abs. in Analyst, 1892, pp. 194, 195.*

The melting point and composition of butter produced under different methods of feeding (*Ueber Schmelzpunkt und chemische Zusammensetzung der Butter bei verschiedener Ernährungsweise der Milchkühe*), A. MAYER.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 15-36.*

The calculation of the value of milk for butter-making (*Die Berechnung des Butterwertes der Milch*), R. KEMPE.—*Molk. Ztg., 1892, No. 35, pp. 426, 427.*

The filtration of water used in creameries (*Ueber Filtration des Molkereigebrauchswassers*).—*Milch Ztg., 1892, No. 38, pp. 641–643.*

Antiseptics and their importance in dairying (*Die Konservierungsmittel und ihre Bedeutung in Molkereibetrieb*), R. KRÜGER.—*Molk. Ztg., 1892, No. 35, pp. 425, 426; No. 36, pp. 439, 440; No. 37, pp. 451, 452; and No. 38, pp. 460–466.*

Koumiss (*Kumys*), R. KOCH.—*Molk. Ztg., 1892, No. 38, pp. 466, 467; No. 39, pp. 478, 479.*

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Transmission of disease by artificial butter, SCALA and ALESSI.—*Atti R. Acad. Med. Roma, 1891; abs. in Zeitsch. Nahrungsmitteluntersuch u. Hyg. 6, p. 24, and Chem. Centralbl., 1892, II, No. 15, p. 658.*

The behavior of cholera, typhoid, and tuberculosis germs in milk, butter, skim milk, and cheese (*Das Verhalten der Krankheitserreger der Cholera, das Unterleibstyphus, und der Tuberkulose in Milch, Butter, Molken, und Käse*), L. HEIM.—*Veröffentl. Gesundheitsamte, 1892; abs. in Milch. Ztg., 1892, No. 38, p. 644, and in Molk. Ztg., 1892, No. 40, p. 493.*

The agricultural relations of North Africa, especially Algiers (*Die landwirthschaftlichen Verhältnisse in Nordafrika, besonders in Algier*), A. L. KRÜGER.—*Fuhling's landw. Ztg., 1892, No. 19, pp. 712–716, and No. 20, pp. 750–754.*

Biographical sketch of Gustav Kühn (with picture), F. NOBBE.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 1-10.*

Biographical sketch of Max Schrodt, A. EMMERLING.—*Landw. Vers. Stat., 41, Heft 1 and 2, pp. 11–14.*

EXPERIMENT STATION NOTES.

PURDUE UNIVERSITY, INDIANA.—A special bulletin on commercial fertilizers, issued August, 1892, by H. A. Huston, State chemist, contains notes on the fertilizer trade in Indiana during 1891, discussions of the agricultural and commercial value of fertilizers, fertilizers for special crops, classification of fertilizers, and adulteration of fertilizers, and tabulated analyses of 241 samples of fertilizers (largely bone and bone mixtures).

"During the past year the number of brands of commercial fertilizers on the Indiana market has considerably increased. During 1891 there were 143 on the market. This increase in the number of brands has not been accompanied by a corresponding increase in the amount of fertilizer sold, the estimated sales for 1891 being 26,750 tons against 29,000 tons for 1890, a decrease of 8 per cent."

LOUISIANA STATIONS.—F. H. Burnette has been elected horticulturist of the State station. H. A. Morgan, B. S., formerly horticulturist and entomologist, will hereafter devote himself exclusively to work in entomology. H. E. L. Horton has resigned his position as chemist of the Sugar Station. E. G. Clark has been appointed farm manager at the Sugar Station vice W. C. Stubbs, jr.

NEBRASKA STATION.—H. H. Nicholson has resigned the directorship, but will continue to be chemist to the station. C. L. Ingersoll has been appointed director and agriculturist. C. Y. Smith has been appointed clerk.

NEW HAMPSHIRE COLLEGE AND STATION.—The station has already removed to Durham, but the college will remain at Hanover until next fall.

OHIO STATION.—Freda Detmers, W. H. Baker, and W. R. Lazenby are no longer members of the station staff.

VETERINARY CONTROL OF CREAMERY HERDS.—On account of the increasing prevalence of tuberculosis in cattle, some of the large coöperative creameries of Germany have decided to require all the cows of their patrons to be placed under veterinary control. The herd of each patron is to be thoroughly examined four times a year, and when a new cow is purchased it is to be examined without delay and before the milk is used. The patrons are required to abide by the decision of the inspecting veterinarian and to at once dispose of any animal pronounced tuberculous.

PRIZE FOR MILK TESTING.—In February, 1891, the German Dairy Association, in coöperation with several other dairy and agricultural associations, offered a prize of 3,000 marks ($750) for the best simple milk test. The judges appointed were Prof. Fleischmann of the Königsberg Station, Dr. Schrodt of the Kiel Station, and Benno Martiny of Berlin. By the following October, the date fixed for the beginning of the testing, eighteen milk tests were entered. Of these, thirteen were discarded for failure to comply with the regulations of the test, leaving only five competing methods. The report of the judges has recently been made public. None of the devices enabled the fat content of milk to be determined as accurately without a balance as by gravimetric methods, and none were sufficiently simple for practical use. Three, however, were deemed worthy of mention. Of these the lactocrite with the new acid mixture stood first and the other two are not described. The Association has awarded 300 marks to the first and 200 marks to each of the others, and proposes

to repeat the offer of a prize at an early date, allowing more time than before for the working out of methods.

In the above trial the Babcock test proved unsatisfactory, chiefly on account of the apparatus furnished with it. The centrifuge was not built solidly enough to allow its being run at the prescribed rate of speed with regularity, and the tubes were not accurately graduated and often broke during whirling. It is suggested that the method might prove more satisfactory with improved apparatus. Recently a German firm placed upon the market improved apparatus for making the test, costing $15. The test with this apparatus is being subjected to rigid trial.

MILK CAKE.—In Volume III, p. 581, of the Record, reference was made to a recently devised mode of utilizing centrifugal skim milk by precipitating the casein from it, mixing the dried casein with some concentrated feeding stuff, and pressing into cakes for feeding stock. The feeding stuff used for mixing with the casein is varied so as to produce a more and a less nitrogenous cake for different purposes. The *Nordisk Mejeri-Tidning* gives the composition of a milk cake intended for feeding young calves as follows: Water 8.85 per cent, protein 24, fat 13.48, carbohydrates 48.17, and ash 5.50.

In feeding the cake is stirred up with water or with water and skim milk. Compared with whole milk the cake contains six times the amount of protein and about four times the amount of fat in the former. The cake is said to cost about one third less than its equivalent of whole milk. Artificial digestion trials indicated that the protein was highly digestible. Feeding trials with young calves resulted satisfactorily. In these trials 1 kg. of the cake was mixed with 1½ kg. of skim milk and 4 liters of water. Calves between 24 and 41 days old ate the mixture readily and in large quantities, showed no ill effects from it, and made good gains.

ASSOCIATION FOR AGRICULTURAL EXPERIMENTATION.—Through the efforts of Prof. W. Kirchner, of the agricultural institute at Leipsic, an association for agricultural experimentation has been formed in the Kingdom of Saxony. Already the Association has about 100 members. It is proposed in 1892 and 1893 to carry on a number of coöperative fertilizer experiments, together with feeding experiments with different breeds of cattle to compare the effect of various rations on the increase in live weight of the animals, the dressed weight, and the quality and cost of the meat produced.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

SEPTEMBER, 1892.

DIVISION OF ENTOMOLOGY:

Insect Life, vol. v, No. 1, September, 1892.

DIVISION OF BOTANY:

Contributions from the U. S. National Herbarium, vol. I, No. 5, September 20, 1892.

DIVISION OF STATISTICS:

Report on the Condition of Crops, September, 1892.

WEATHER BUREAU:

Monthly Weather Review, June, 1892.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

SEPTEMBER, 1892.

COLORADO AGRICULTURAL EXPERIMENT STATION:

Fourth Annual Report, 1891.

Bulletin No. 20, August, 1892.—The Best Milk Tester for the Practical Use of the Farmer and Dairyman; The Influence of Food upon the Pure Fat Present in Milk.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 113, September, 1892.—Notice as to Bulletins and Annual Reports; Fertilizers.

GEORGIA EXPERIMENT STATION:

Circular No. 2.—Crop Report for June, 1892.

IOWA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 18, August, 1892.—Experiments with sheep; Feeding Colts; Sweet *vs.* Sour-Cream Butter; Diseases of Plants Common to Iowa Cereals; Reports on Injurious Insects; The Apple Trees and Apple Crop on the College Farm; A Separating Experiment; Experimental Creamery.

KANSAS AGRICULTURAL EXPERIMENT STATION:

First Annual Report, 1891.

Bulletin No. 33, August, 1892.—Experiments with Wheat.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 42, September, 1892.—Experiments with Wheat and Oats.

MAINE STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Annual Report, 1891, part V.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 43, August, 1892.—Weather Observations; Winter Feeding Experiments with Lambs; Miscellaneous Analyses of Materials Used for Manurial Purposes; Analyses of Licensed Commercial Fertilizers.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 44, August, 1892.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 87, September, 1892.—Smut in Oats and Wheat, Jensen or Hot Water Treatment.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Bulletin No. 24, September 15, 1892.—Notes on Certain Caterpillars Attacking Sugar Beets.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 42, September, 1892.—Second Report upon Electro-Horticulture.

Bulletin No. 43, September, 1892.—Some Troubles of Winter Tomatoes.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 42, August, 1892.—Field Experiments with Wheat.

Bulletin No. 43, September, 1892.—Greenhouses and Greenhouse Work; Tomatoes and Lettuce as Greenhouse Crops; The Food of the Robin.

OKLAHOMA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 3, June. 1892.—Insects and Insecticides.

THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 20, July, 1892.—Tests of Dairy Apparatus.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 18, August, 1892.—Fertilizers.

TENNESSEE AGRICULTURAL EXPERIMENT STATION:

Bulletin vol. v. No. 3, July, 1892.—A Contribution to the Study of the Economies of Milk Production.

WASHINGTON AGRICULTURAL EXPERIMENT STATION:

First Annual Report, 1891.

WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 25, August, 1892.—Plat Experiments with Commercial Fertilizers on Wheat.

EXPERIMENT STATION RECORD.

VOL. IV. NOVEMBER, 1892. No. 4.

An interesting experiment with Koch's tuberculin as a means of determining whether cattle are affected with tuberculosis, is reported in Bulletin No. 21 of the Pennsylvania Station, an abstract of which may be found on page 359. More than fifty animals were included in the test, in only two of which the characteristic rise of temperature was produced by the injection of the tuberculin. One of these was pronounced healthy by a skilled veterinarian who made an independent physical examination of the herd. At the same time his diagnosis pointed out three animals as probably tuberculous which were not brought under suspicion by the Koch test. A post-mortem examination showed that the tuberculin had been a sure means of diagnosis, while the physical examination had been at fault in indicating that animals were tuberculous which were really suffering from noncontagious lesions of the lungs. The present status of this question in Europe is thus summed up in an editorial in the *Berliner Thierärztliche Wochenschrift* of June 16, 1892, as translated in the bulletin of the Pennsylvania Station above referred to:

We shall now stop publishing reports on tuberculin in the *Berlin Veterinary Weekly* unless they contain some new facts or views. Since the publication of the reports of the extensive experiments of the Royal Health Office we may regard the question of the value of tuberculin in the diagnosis of tuberculosis of cattle as settled.

The proof which has been presented to our readers is more than sufficient. The results are absolute and gratifying, and show that tuberculin is a reliable agent for determining the presence of tuberculosis in cattle.

Koch's discovery has been of extraordinary value to veterinary science, and the few cases in which the results obtained from the use of tuberculin were not satisfactory do not detract from the value of the discovery. The exceptions are of still less importance since they comprise only cases in which animals reacted without being tuberculous. But since these animals invariably suffered from other serious diseases, the owners did not experience loss from the slaughter in consequence of the reaction. On the contrary, when animals do not react after the injection of tuberculin it can be said with almost absolute certainty that they are free from tuberculosis, since not a single case has been unquestionably established in which animals containing tubercles have not reacted.

When we consider the insidious and dangerous character of tuberculosis as a disease which may not only be transmitted from animal to animal but from animals to men, the practical importance of the discovery of this scientific means of diagnosis appears to be very great. Certainly it should be resorted to whenever there is reason to suppose that tuberculosis exists in any herd. In the case of cows kept for supplying milk for family use it may even be found desirable to make periodical tests for tuberculosis. There is an increasing amount of evidence that a considerable share of the mortality among infants is due to some form of this dread disease. How much of this is derived from infected milk has not been determined, but it seems to be clearly shown that the milk of tuberculous cows frequently contains the bacillus of tuberculosis, even when the udder is healthy. This matter is worthy of careful investigation by boards of health and departments of milk inspection. Koch's tuberculin has proved a failure as a direct agent for the cure of tuberculosis, but it apparently has a great future as one of those preventive remedies the widespread use of which will after a time greatly reduce, if not entirely banish, the ravages of contagious diseases.

In the pursuit of purely practical results which may satisfy the demands of the farming constituency, opportunities for collecting data of scientific interest are often overlooked by station workers. A striking instance of this is furnished by the feeding experiments with dairy cows. A large proportion of these experiments are made with the prime object of comparing the effect of different feeding stuffs or of different rations on the cost of milk production. The method commonly followed in such cases is to record the amount of food eaten and of milk produced in each period; calculate the gross and perhaps the net cost of the food per quart or per pound of milk produced; notice the changes in live weight of the cows; and ascertain the composition of the milk at intervals of one or two weeks. Such experiments may serve to show for a given set of conditions the cost of milk with different feeding stuffs. They may also indicate, though less accurately, the cost of food per pound of butter fat. But regarding the actual composition of the milk and the absolute yield of milk ingredients in different periods, such experiments teach little if anything. The variation in the composition of the milk of a single cow from day to day has often been shown to be great, and it has been urged that in order to determine the character of the milk for any period the analyses must be frequent. The introduction of reliable rapid methods for testing milk has made it practicable to include in such experiments a study of the composition of the milk of the individual cows on trial. By means of composite samples and a rapid milk test the milk of each cow might be tested for fat morning and night daily. From these results and the specific gravity the percentage of solids could be calculated by reliable

formulas. Without in any way detracting from the interest of the experiment from a practical point of view, and without any very considerable extra work or expense, data could thus be secured which would often be extremely interesting and valuable from a scientific standpoint. In the aggregate such data might go a long way toward clearing up the much-disputed question of the effect of food on the yield and composition of milk.

According to a recent account of the experiment station movement in Portugal published in *Die Landwirtschaftliche Versuchs-Stationen*, that country contains at present three stations. Of the twelve stations planned only five were established, and two of these have recently been abandoned. The remaining three are located at Lisbon, Oporto, and Evora. The director of the first is Ramiro Larcher-Marcal; of the second, Guilh. Adv. de Silveira; and of the third, Antonio Gomes Ramalho. Each station has a director of the chemical laboratory, with an assistant.

Roumania has one experiment station (*Statiunea agronomica*), which was established at Bucharest in 1887, under the directorship of Cornelius Roman. The station is about to be reorganized, with an increased appropriation. The first annual report will soon be translated into the German language.

AGRICULTURAL EDUCATION IN ITALY.

L. PAPARELLI.

Agricultural education in Italy is at present mainly under the direction of the Ministry of Agriculture, but partly under that of the Ministry of Public Instruction. It is distributed in the following schools and courses: (1) High schools of agriculture; (2) special agricultural schools, and sections of agriculture and survey in technical institutes; (3) practical schools of agriculture; (4) courses of rural economy and agriculture in universities; (5) special short courses given at experiment stations; (6) itinerant chairs of agriculture and of viticulture; (7) courses of agriculture in normal and technical schools; (8) agricultural instruction in elementary schools; (9) private schools of agriculture. Besides these regular schools and courses instruction on subjects of special interest is given every year in different districts of the Kingdom.

Royal high schools of agriculture.—There are at present in the Kingdom three high schools of agriculture, at Milan, Pisa, and Portici. The school at Pisa is connected with the Royal University and is under the control of the Ministry of Public Instruction, while those at Milan and Portici are autonomous and depend upon the Ministry of Agriculture.

The school at Milan was established in 1870 and that at Portici in 1872. They are organized in the same manner, though with some modifications in the courses which are rendered necessary by the different climatic conditions and by other causes. Their objects are to give young men who have completed their studies in a lyceum or in a technical institute a scientific and practical knowledge of agriculture and rural industries, corresponding to the actual status of science; to provide special instruction for those desiring to become professors in the agricultural branches; and to promote the progress of agriculture by means of experimental investigations.

The average number of students in each school is about fifty. The regular course of study lasts three years. The graduates of high standing who intend to become professors are admitted to the course of "Magistero," which lasts two years. At Portici the triennial course is arranged as follows:

First year: General agriculture, sericulture, apiculture, animal anatomy and physiology, inorganic chemistry, analytical chemistry, agri-

cultural physics, meteorology, morphological and systematic botany, agricultural geology, mineralogy, and drawing.

Second year: Special agriculture, zoötechnics, surveying, industrial drawing, organic chemistry, agricultural chemistry, analytical chemistry, physiological botany, vegetable microscopy, agricultural entomology, rural laws, political economy, and statistics.

Third year: Rural economy, bookkeeping, rural estimation, arboriculture, horticulture, viticulture, olive culture, forestry, practical zoötechnics, diseases of animals, surveying, hydraulics, drainage, agricultural chemistry, chemico-rural technology, vegetable pathology, rural mechanics, construction, industrial drawing, wine-making, oil-making, and dairying.

The income of these schools amounts to about $24,000 each per annum, of which three fifths are given by the Government and two fifths by the Province and the city. Each regular student pays $28 yearly, viz, $20 for the lectures and $8 for the use of the laboratories. The graduating fees amount to $20 per student. Special students pay $4 for each course taken and $3 for each certificate of studies. Upon examination two scholarships are given every year for the benefit of students either in the triennial regular course or in the "Magistero" course. Besides these the graduates are given full fellowships for some special branches to be studied in schools of the State or in those of foreign countries.

The school at Pisa, which has been established much longer, differs from the two above mentioned by having a course of study lasting four years, but at the end of the fourth year graduates may also have the "Diploma of Magistero," for which they must matriculate at the beginning of their senior or last year in order to follow some special courses required to complete their agricultural instruction and to fit them to become professors.

These three schools are well equipped with scientific and technical laboratories, museums, experimental fields, meteorological observatories, libraries, etc. Most of the graduates become professors in other schools and officers in experiment stations, or occupy other Government positions; there are only a few who devote themselves to farming. It is the intention of the Ministry of Agriculture to establish the regulation that all graduating students of the schools of Milan and Portici shall spend one additional year in practice on the farm of the new school of viticulture at Perugia before getting their diplomas. The school at Perugia owns more than 5,900 acres of land, divided into five farms, representing all cultures and industries, and doubtless will be a splendid field for the practical instruction of the students. The results of experiments and investigations carried on by the personnel of these institutions are published in the Annals of each school, in the Journal of the Agricultural Experiment Stations, in the official publications of the Ministry of Agriculture, and in other scientific reviews.

Special agricultural schools.—These schools have been established with the purpose of educating experts for some of the most important cultures and industries. At present there are the following special schools: Royal Institute of Forestry at Vallombrosa, Tuscany; Royal Schools of Viticulture and Oenology at Conegliano, Alba, Avellino, Perugia, Catania (Sicily), and Cagliari (Sardinia); Royal School of Zoötechnics and Dairying at Reggio d'Emilia; Royal Zoötechnical Institute at Palermo, Sicily; Royal School of Pomology and Horticulture at Florence, Tuscany; Royal School of Olive Culture and Oil-Making at Bari, Puglie.

Institute of Forestry at Vallombrosa.—As early as 1869 the Ministry of Agriculture established a school of forestry in the ancient Abbey of Vallombrosa. This place was very suitable for such an institution on account of the amenity of its climate, its healthy location, its nearness to large and beautiful forests, and also because of the large abbey building. This school is about 23 miles distant from Florence. The building stands about 3,117 feet above the sea level, and the mountains behind it reach 4,698 feet in height. The forests annexed to the school cover about 3,632 acres, and include magnificent representatives of forests of chestnuts, beeches, and conifers.

The course of study lasts four years. The scholastic year extends from March to November. The students are divided into ordinary and extraordinary. To the first category belong those who enter the Government service, to the second category those who attend the school with the sole object of learning forestry.

The number of students that can be admitted each year is determined by the Ministry of Agriculture, and is arranged in such a manner as not to exceed forty in the four years' course. Admission is obtained by competitive examinations in the following branches: Italian and French, geography, natural history, mathematics, physics, and chemistry. However, a certain number of students who are graduates (*licentiates*) of a lyceum or of the agricultural and physico-mathematical sections of a technical institute, may be admitted without examination. The students board and lodge in the institute, to which they pay $120 per annum. They wear the official uniform of the institute, which resembles that of the Government forest officers.

The best student of the graduating class may be sent at the expense of the State to study for some time in foreign countries. All the ordinary graduate students enter the State service with the title of Vice Inspector of Forests. All students that pass satisfactory examinations at the end of the course are granted the diploma of Forestry Expert (*Perito Forestale*).

Every year the students, under the direction of a professor designated by the Ministry, are allowed to make a scientific and practical excursion in the forests either of the state or of private individuals. Practical work is required in the forests of Vallombrosa, in the nurseries, and in

the laboratories and cabinets of physics, chemistry, natural history, dendrology, etc. A well-equipped library is at the disposal of the professors and students.

The branches taught in the Institute of Vallombrosa are as follows:

First year: Italian literature, French language, inorganic and analytical chemistry, mineralogy, geology, physics (with laboratory work), morphology and classification of plants, advanced algebra, geometry, and drawing.

Second year: Italian literature, French language, zoölogy, organic chemistry applied to forestry, systematic botany, forest economy and technology, German language, drawing, trigonometry, and analytical geometry.

Third year: Surveying, forestry mathematics, forestry (plan, management, protection, etc.), German language, mechanics, vegetable pathology and physiology, and general and special agriculture.

Fourth year: Estimation of forests (with practice of surveying), forestry (forest regulations, practical application), forest laws, civil, road, and hydraulic architecture applied to forestry, botanical geography, German language, and drawing.

For the year 1891–'92 the income of the institute was $10,020; this sum also covered the other outside expenses for the dissemination of forest instruction.

Royal schools of viticulture and œnology.—The object of these schools is to train technical directors for important vineyards and wineries, managers for vineyards, and cellar masters. Two independent courses are offered, one of four and the other of two or three years. The subjects embraced in the four years' course are Italian literature, French, German, or English, history, geography, mathematics, physics, mechanics, surveying, drawing, bookkeeping, mineralogy, geology, zoölogy, botany, chemistry, vegetable pathology, agriculture, viticulture, œnology, chemical technology of wines and secondary products, laws regarding the wine industry, and commerce. From two to six hours per day are occupied in practical work in the cabinets, laboratories, vineyards, cellars, and distillery. Besides the work of instruction, these schools carry on investigations regarding the culture and diseases of grapes and other cultivated plants, the preparation and conservation of wines, and other subjects connected with related industries.

Royal School of Zoötechnics and Dairying at Reggio d'Emilia.—This school was established in 1879 with the object of preparing experts for raising animals and for dairying. The theoretical and practical instruction is given in a biennial course, though graduate students of good standing may have a third year of advanced study. Besides the instruction, the school carries on investigations and experiments concerning zoötechnics and dairying. The subjects taught are Italian language, history, geography, mathematics, bookkeeping, mineralogy, geology, botany, physics, general and applied chemistry, dairying, ani-

mal anatomy, physiology, zoögony, hygiene, zoölogy, zoötechnics, and penmanship. The practical work is obligatory, and varies from five to eight hours daily.

The students of the advanced course attend special lectures on zoötechnics, dairying, applied chemistry, etc., and take part in the practical work of the dairy, the chemical laboratory, and the stables. For their work they receive a certain sum, which is subtracted from that required for their living at the school.

Royal Zoötechnical Institute at Palermo.—This institution, established in 1884, has for its objects (1) to disseminate in the Island of Sicily selected breeds of the races of domestic animals best adapted to local conditions; (2) to favor the raising of imported animals and to experiment in crossing with native races, supplying the breeding animals to the farmers; (3) to promote the improvement of native races by selection; (4) to serve as a breeding station; (5) to promote the culture, harvesting, and curing of forage plants with reference to maintaining an adequate food supply for domestic animals during times of drouth; (6) to promote the increase of domestic animals in the island, and to disseminate, by means of publications, by lectures, and even by the admission of students to the institute, the proper practice of zoötechnics and prairie culture. The scientific personnel of the institute includes a director and a veterinary surgeon. The annual expense of the institute amounts to about $1,400.

Royal School of Pomology and Horticulture at Florence.—This school, which was established in 1882, has for its object the training of experts in pomology and horticulture. The instruction is given in three years and is mostly practical. The branches taught are the following: Italian, French, history, geography, mathematics, bookkeeping, physics, chemistry, meteorology, botany, zoölogy, cultivation of fruit and vegetables, landscape gardening, floriculture, surveying, drawing, and penmanship.

Royal School of Olive Culture and Oil-Making at Bari.—This school was established in 1881, to give special instruction to persons intending to become olive culturists and oil makers. The students work from five to eight hours daily on the farm and in the olive orchard and oil mill. This practical work is accompanied by lectures on the elements of the following branches during a three-years' course: Italian language, history, geography, mathematics, bookkeeping, drawing, penmanship, general and special agriculture, zoötechnics, rural economy, natural history, botany, zoölogy, geology, mineralogy, olive culture, oil-making, rural industries, and surveying.

Sections of agriculture and surveying in the royal technical institutes.—These institutes or colleges were established in 1859, and are under the direction of the Ministry of Public Instruction. The sections that may be in each college are the following: (1) Physico-mathematical, (2) agricultural, (3) surveying, (4) commercial, (5) industrial. Their

object is to prepare experts in the different lines. There are at present in Italy sixty technical institutes, distributed in the different provinces of the State.

Royal practical schools of agriculture.—The systematic establishment of these schools was begun in 1880, with the understanding that gradually each province should be provided with one or even two or three of these schools. At present there are in Italy twenty-four practical schools of agriculture. Their object is the dissemination of an elementary theoretical and practical knowledge of agriculture and related industries. The regular course of instruction is given in three years, but if necessary a fourth year may be added, with a special program. The program of studies is the same for all practical schools, though there may be some modifications rendered necessary by local needs of the schools. The branches taught in the triennial course are the following: Italian language, history, geography, mathematics, botany, physics, drawing, general bookkeeping, agriculture, chemistry, zoölogy, zoötechnics, and surveying. Practical work is obligatory for six to seven hours daily. The students of these schools, as well as those of special schools of agriculture, also receive instruction in military drill once a week. All who have received an elementary education can be admitted to these schools. Students lodge and board in the school, to which they pay about $70 yearly. Each school is well provided with laboratories, machines, and farms for the technical instruction of the students.

Courses of rural economy and agriculture in universities or high institutes.—A chair of rural economy and estimation is maintained in the royal schools of applied engineering, which, with few exceptions, are connected with universities. These schools are located at Turin, Rome, Naples, Padua, Bologna, Pisa, and Palermo. Courses in agriculture and rural economy and estimation are given in the Royal Polytechnic Institute at Milan and at the University of Perugia. These schools are under the direction of the Ministry of Public Instruction.

Special short courses at experiment stations.—Courses in silk culture, one for men and another for women, are given every year at the Royal Station of Sericulture in Padua. The Ministry of Agriculture, in order to favor the provinces where sericulture has or may have a special importance, grants yearly a certain number of scholarships to such provinces. Those who complete the theoretical and practical course of the station and pass a satisfactory examination are given the title of Director of Observatory of Sericulture.

Special courses of sericulture and apiculture are also given in the high schools of agriculture at Milan and Portici. In the latter has been established an apiary, intended principally for instruction.

A special theoretical and practical course in dairying is given every year in the Royal Station of Dairying at Lodi. The course lasts three months, from September 1 to November 30. Those who complete the

course and pass a satisfactory examination both in the theory and practice of dairying are given the title of Director of Dairy Observatories. For this course also the Ministry of Agriculture puts at the disposition of the provinces a certain number of scholarships. Practical instruction in dairying is given yearly also in the dairy observatories and in several of the practical schools of agriculture.

Itinerant chairs of agriculture, viticulture, and œnology.—This kind of instruction was started in 1887, but has only developed recently, especially in the lines of viticulture and œnology. At present there is an itinerant chair of agriculture in the region of Polesine, with headquarters at Rovigo, and there are five itinerant chairs of viticulture and œnology at Gattinara (Province of Novara), Solmona (Aquila), Marino (Rome), Rionero in Volture (Potenza), and Nicastro (Catanzaro). The task of each chair is the careful study of the conditions of the localities, to know what is done and why it is done, in agriculture, in viticulture, and in œnology, and hence inculcate by any possible means (by lectures, by practical experiments in the fields, in vineyards, and in cellars, by analyses of the products, etc.) what should be done and what could be done better. It is the advice of the Ministry of Agriculture that at the end of five years at most the location of the chair should change. Great practical benefits are derived from such instruction, and many other provinces are asking the Ministry for the establishment of these chairs.

Courses of agriculture in normal and technical schools.—By an agreement between the Ministries of Agriculture and of Public Instruction, since 1866 agricultural instruction has been introduced in normal schools, but it was rendered obligatory in 1880. Most of the schools have an agricultural garden. The expenses of instruction are divided equally between the two Ministries. The Ministry of Agriculture also gives subsidies from time to time.

The number of normal schools for men which have the regular income from the Ministries is twenty. In normal schools for women agricultural instruction was started in 1879–'80 in the school of Udine. This school has a special agricultural section, with a biennial course. Most of the women who at present teach agriculture in other normal schools come from that section. Ten other normal schools for women have agricultural instruction. The students are taught the fundamental principles of agriculture, horticulture, fruit culture, and floriculture; also sericulture, apiculture, aviculture, etc., and the preparation and and conservation of alimentary products.

In the Queen Margherita's College at Anagni (Rome) there is a special lady teacher for agriculture. The school has also an agricultural garden, where the students can do practical work. This instruction was organized in 1890. The expenses are borne by the Ministry of Agriculture.

In the technical schools of Citta di Castello, Fano, and Rimini an additional fourth-year course has been established for instruction in theoretical and practical agriculture.

Agricultural instruction in elementary schools, agricultural colonies, etc.—This instruction was recommended by the Ministry of Agriculture in the early seventies, but it has been put in regular operation only during late years. The instruction is given by teachers who have attended regularly a normal school where agriculture is taught, or by teachers who have attended with success the course of agricultural lectures promoted by the Ministry of Agriculture. In the scholastic year of 1890–'91 the number of teachers who gave instruction in agriculture in elementary schools was five hundred and fifty-five. The Ministry of Agriculture gives every year a subsidy to the teachers in charge of this instruction besides their ordinary duties.

Elementary instruction, but entirely practical, is given in the so-called agricultural colonies, which are provided with more or less extensive farms, where the work is done by the pupils themselves. These institutions are of two classes, free colonies and reformatory colonies. In both the pupils admitted come from poor families and sometimes are orphans or foundlings. The reformatory colonies are exclusively intended for youths of bad instincts. There moral education is combined with practical instruction in agriculture and rural industries, as in the free colonies.

Private agricultural schools.—Elementary and practical instruction in agricultural branches is also given in several private institutions, which the Government aids and over which it exercises some surveillance by approval of the programs of studies, by the granting of subsidies, by inspection, or by sending an official representative to the final examinations.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

BOTANY.

A. C. TRUE, *Editor.*

Report of botanist for 1891, F. L. HARVEY (*Maine Sta. Report for 1891, pp. 175–187, plate 1*).—A résumé of the work done during 1891 in the following lines: (1) Tests of the vitality and purity of seeds; (2) notes on weeds; (3) examination of several species of mosses with reference to their value as forage plants; (4) the continuation of the study of potato rot and black knot; (5) extension of the station herbarium. In the chemical examination of mosses one species, *Hypnum splendens*, was found to contain as much nitrogenous matter as timothy hay, but its degree of digestibility was only 36 per cent as compared with 72 per cent for timothy. Brief notes are given on the following species of weeds: Jamestown weed or thorn apple (*Datura stramonium*), white radish (*Raphanus raphanistrum*), yellow dock (*Rumex crispus*), and chess or cheat (*Bromus secalinus*).

METEOROLOGY.

Meteorological observations, L. G. CARPENTER (*Colorado Sta. Report for 1891, pp. 57–72, 78–84, 89–97, diagram 1*).—Tables give the total amount and daily variations (forenoon and afternoon) of sunshine for each month of 1891 at Fort Collins, Rocky Ford, and San Luis; daily thermometer readings and range of temperature for each month, and average daily barometric pressure at Fort Collins; the comparative meteorological conditions at Fort Collins and Manhattan (difference in elevation 3,500 feet), and annual summaries of meteorological observations at the station (Fort Collins) and at the Divide, San Luis, and Arkansas Valley Substations.

Comparative observations at Fort Collins and Manhattan.

	Temperature (degrees F.).				Mean dew-point.	Mean relative humidity.
	Mean, 7 a. m.	Mean, 7 p. m.	Minimum, 7 a. m.	Daily mean.		
Fort Collins	39.29	45.26	—13.70	36.85	25.78	65.57
Manhattan	37.40	36.30	— 5.00	42.28	31.55	69.41

Meteorological summary, January–July, 1892 (*Massachusetts State Sta. Bul. No. 43, Aug., 1892, p. 1*).—A tabular statement of the highest, lowest, and mean temperature, precipitation, prevailing wind, and cloudiness for the first seven months of 1892. The maximum temperature was 94.5° F. (June 4), the minimum 10° (January 17), and the mean 45.58°.

SOILS.

W. H. BEAL, *Editor.*

Soil temperatures and terrestrial radiation, L. G. CARPENTER (*Colorado Sta. Report for 1891, pp. 73–78, 85–88*).—A tabular record and diagram show the weekly means of soil temperatures at depths of from 3 to 72 inches for three sets of soil thermometers placed in soils varying in elevation and moisture. "Set A is on a slope facing south, grassed, in a sandy clay soil. Set B is in a low place with dark soil and ground water at a depth of about 5 feet; this is subject to irrigation. Set C is on a knoll near the college barn and on the northern slope."

Soil temperatures at different depths.

Depths.	Set.	Maximum.	Date.	Minimum.	Date.	Range.
		Degrees.		*Degrees.*		*Degrees.*
3 inches	A	84.0	July 24	17.8	February 9	66.2
6 inches	A	80.6	July 11	21.9	February 10	58.7
	B	69.8	July 9	28.5	February 12	41.3
	C	77.7	July 23	23.2	....do	54.5
12 inches	B	66.8	August 15	31.4	....do	35.4
	C	75.3	July 23	26 0	....do	49.3
24 inches	A	68.7	July 26	32.1	February 14, 16, and 17.	36.6
	B	63.7	August 15	34.6	March 14	29.1
	C	71.8	July 30	30.7	February 12	41.1
36 inches	A	65.6	August 16, 17, 19, and 20.	34.0	February 19, 22, 23, and 26.	31.6
	B	62.2	August 20	36.6	March 14	25.6
	C	67.4	July 30	34.1	February 19	33.3
72 inches	A	63.8	September 17	39.0	March 12–23	24.8
	B	68.5	August 20	40.5	March 14 and April 10.	28.0

"A comparison of the temperatures at the different depths will show that during the winter season the soil is coldest at the surface, and that as warming takes place the surface warms the fastest, so that after the 1st of April the surface becomes the warmest."

Daily readings of terrestrial radiation thermometers for each month of 1891 are also tabulated.

FERTILIZERS.

W. H. BEAL, *Editor.*

On the Gunning-Kjeldahl method and a modification applicable in the presence of nitrates, A. L. WINTON (*Connecticut State Sta. Bul. No. 112, June, 1892, pp. 4*).—Comparative determinations of nitrogen in cotton-seed meal, castor pomace, tankage, bone, fish, guano, and mixed fertilizers free from nitrates by the Kjeldahl and Gunning methods, are reported. These results, as well as those "obtained by Gunning,* Atterberg,† Van Slyke,‡ and others, on fodders, dairy products, fertilizers free from nitrates, and various organic substances, show that this [the Gunning] method is fully as accurate as the ordinary Kjeldahl method and in some cases gives better results." It also appears to possess the advantage of being applicable to the determination of nitrogen in various alkaloids, azo-compounds, and bodies of the aromatic series. It is not, however, applicable to the determination of nitrogen in nitrates, and for the general purposes of fertilizer analysis it is very desirable to have a method which secures this result. A modification of the Gunning method, which has given satisfactory results in this respect, is described as follows:

The material, 0.5 to 1 gram, is digested with 30 c. c. of Scovell's salicylic-acid mixture (30 c. c of sulphuric acid and 2 grams of salicylic acid) in a flask of 600 c. c. capacity for two hours, with frequent shaking. Two grams of zinc dust are then slowly added, with continual shaking, and the flask heated, at first gently, until after a few minutes' boiling dense fumes are no longer given off. Thus far the process is the same as in the Scovell-Kjeldahl method (the official method of the Association of Official Agricultural Chemists), except that the digestion is continued for two hours, which in some cases the writer has found absolutely necessary in order to secure complete solution of the nitrate. Ten to 12 grams of potassium sulphate are next added and the boiling continued for a little time after the solution is colorless, or, if iron is present, has a light straw color which remains unchanged. On cooling, as the mixture begins to solidify, water is added, at first slowly, with shaking, and the distillation with caustic soda is carried on in the usual manner.

[A table gives the results obtained on nitrates and fertilizers containing nitrates] by the official method and the method here described, together with the percentage of nitrogen in nitrates as determined by the Schulze-Tiemann method.

The average of the twenty-five determinations by the Scovell-Jodlbauer method is 4.64 per cent; by the proposed method, 4.65. The greatest discrepancy in any instance is one tenth per cent; the average discrepancy, 0.05 per cent. In ten cases the proposed method gave the lower result; in thirteen cases, the higher result.

Analyses of cotton-seed meal and cotton-hull ashes (*Connecticut State Sta. Bul. No. 113, Sept., 1892, pp. 7*).—Tabulated analyses of 9 samples of cotton-seed meal and 23 of cotton-hull ashes, together with trade values for 1892 of fertilizing ingredients in raw materials and chemicals, and notes on valuation.

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* Zeitsch. anal. Chem., 28, 188.
† Chem. Zeitsch., 14, 509.
‡ U. S. Dept. Agr., Div. Chem. Bul. 31, 142.

The average composition of the 9 samples [of cotton-seed meal] analyzed this year is, nitrogen 7.06 per cent, phosphoric acid 2.67 per cent, potash 1.73 per cent. The average cost of nitrogen in cotton-seed meal has been 14.9 cents per pound, and the extremes were 14.0 and 16.3 cents per pound.

The average cost of the ashes, excluding 4 samples [admitted to be of inferior quality], was $36.31 per ton, and the average valuation $40.56. Or, differently expressed, water-soluble potash cost 4.8 cents on the average. In individual cases water-soluble potash cost 3.2 cents per pound at the lowest and 6.3 cents at the highest.

Fertilizers, N. T. LUPTON (*Alabama College Sta. Bul. No. 38, July, 1892, pp. 63*).—This is a report on fertilizer inspection in Alabama for the nine months ending July 1, 1892, and includes statistics of the fertilizer trade in Alabama; notes on valuation; a brief discussion of the nature and extent of the phosphate deposits of Florida; tabulated analyses of 357 samples of fertilizing materials, including compound fertilizers, tankage, natural phosphates, marl, and clay; a list of guarantied analyses of commercial fertilizers, filed in the office of the commissioner of agriculture by dealers and manufacturers, and of licenses issued; and the text of laws relating to fertilizers in the State.

The number of tons [of fertilizers] sold in Alabama during the past five years, according to the record kept in the office of the commissioner of agriculture, is as follows: Season of 1887-'88, 62,575 tons; 1888-'89, 71,605; 1889-'90, 99,818; 1890-'91, 115,735; 1891-'92, 83,323.

The decrease of about 28 per cent in sales during the present season, as shown in the above statement, is not attributable to a lack of appreciation of the value of fertilizers so much as to the depreciation in the price of cotton and reduction in the acreage placed under cultivation. In Georgia over 300,000 tons were sold last year, while during the season now closing the sales have not much exceeded 200,000 tons. A similar decrease has prevailed generally in the cotton-growing States.

The market value of manufactured fertilizers has undergone very little if any change since last year.

Analyses of fertilizers (*Massachusetts State Sta. Bul. No. 43, Aug., 1892, pp. 8-12*).—Tabulated analyses of 47 samples of fertilizing materials, including compound fertilizers, bone, wood ashes, cotton-hull ashes, and Florida phosphate, and a statement of the basis of valuation of fertilizers for 1892.

Fertilizer inspection in Rhode Island, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Bul. No. 18, Aug., 1892, pp. 53-58*).—Analyses of 29 samples of commercial fertilizers. The advisability of buying wood ashes (which are subject to inspection in Rhode Island) only upon guaranty of composition is urged upon purchasers.

FIELD CROPS.

A. C. TRUE, *Editor.*

Removing tassels from corn, G. C. WATSON (*New York Cornell Sta. Bul. No. 40, July, 1892, pp. 97–103*).

Synopsis.—Two experiments are reported, in one of which the tassels were removed from alternate rows and in the other from three fourths of the rows. The results showed no uniformity in gain or loss in yield from removing the tassels. Similar experiments at other stations are cited. The weight and composition of anthers and pollen from selected stalks are given.

A report on two experiments in continuation of that recorded in Bulletin No. 25 of the station (E. S. R., vol. II, p. 505). In one experiment the tassels were removed by hand, soon after they appeared, from alternate rows in a plat containing twenty-five rows of seventy-two hills each. In the other experiment the tassels were removed from three fourths of the rows in a plat containing twenty-one rows of seventy-two hills each.

The variety of corn was Sibley Pride of the North. It was planted the last week in April, in fertile, dry, gravelly soil, in hills $3\frac{1}{2}$ feet apart in the row and rows 3 feet 8 inches apart. The first tassels were removed July 24, 1891, and on each of the following dates all tassels were removed that had made their appearance since the previous picking: July 28, and August 1, 7, and 15. The corn was allowed to stand until fully ripe.

The results as given in detail in tables "show that there was no marked gain from removing the tassels and no uniformity in gain or loss in yield with respect to the treated and untreated rows. * * * The synopsis of the results of this experiment is given in the following table, with those of the experiment of the previous year:"

	Comparative yield, 1891.		Comparative yield, 1890.	
	Tassels left on.	Tassels removed.	Tassels left on.	Tassels removed.
Number of good ears	100	109	100	151
Number of poor ears	100	110	100	141
Number of abortive ears	100	142	100	37
Total number of ears	100	121	100	88
Weight of good ears, pounds	100	99	100	152
Weight of poor ears, pounds	100	110	100	144
Number of stalks	100	98	100	101

The results of similar experiments at other stations are given from the following publications: Bulletin No. 20 of the Illinois Station, Annual Report of the Maryland Station for 1891, Bulletin No. 19 of the Nebraska Station, and Bulletin No. 30 of the Kansas Station (E. S. R., vol. III, p. 849; IV, p. 37; III, p. 703; III, p. 858).

The results of the experiment at the Illinois station and the one made here last year practically show no gain or loss in corn production. Those made at the Maryland and Nebraska Stations show a loss, while the Kansas experiment and ours of 1890 show a marked increase. * * *

To get some idea, if possible, of the amount of plant food lost to the plant and given off in the form of anthers and pollen, the following test was made in the university cornfield last year, on the same variety of corn and under similar conditions as was the detasseling experiment.

Large paper bags were tied over the tassels before they had become expanded, the bags being of sufficient size to allow the tassel to expand, and were securely tied about the stalk to prevent the escape of any pollen. These bags were tied on the stalks July 30 to August 3 and taken to the station chemist, Mr. H. Snyder, August 13, who reported that an average of six stalks gave 7.02 grams of anthers and 3.49 grams of pollen. An analysis of the anthers and pollen gave the following composition:

	Anthers.	Pollen.
	Per cent.	*Per cent.*
Water	24.56	27.27
Ash	4.73	2.13
Fat (ether extract)	2.07	0.94
Crude fiber	14.49	....
Crude protein	14.27	17.11
Carbohydrates (nitrogen-free extract)	39.88	52 55
	100.00	100.00

Allowing the corn to be planted in hills 3 feet 6 inches apart each way, and three stalks to the hill, the amount and composition of pollen per stalk will give 2.25 pounds of nitrogen per acre, and the anthers will give 3.76 pounds per acre, or 6.01 pounds in all, which makes the loss of nitrogen to the plant very considerable, equal to a very liberal application of nitrogen in the form of commercial fertilizers.

Experiments with corn and cotton at Louisiana State Station, 1891, D. N. BARROW (*Louisiana Stas. Bul. No. 17, 2d ser., pp. 488–496*).—The experiments reported in this bulletin were in continuation of those recorded in Bulletin No. 7 (second series) of the station (E. S. R., vol. II, p. 571). The season was characterized by extremes of wet and dry weather, which materially affected the results of the experiments.

Corn, test of varieties (p. 489).—Fourteen varieties were planted, but the results were not considered worth reporting in detail.

Corn, planting at different distances (pp. 489, 490).—Notes and tabulated data on an experiment in which corn was planted in rows 4 and 5 feet apart, at distances of 18 and 24 inches apart in the row and thinned to one and two stalks in the hill. The best results were with one stalk in hills 18 inches apart in 5-foot rows.

Corn, flat culture (p. 490).—The yields from growing one stalk in hills 3 feet apart in 4-foot rows with flat culture was 52.7 bushels per acre in 1891 as compared with 42.4 bushels in 1890. The difference in yield is attributed primarily to difference in the seasons.

Corn, experiments with fertilizers (pp. 490–494).—An experiment in applying fertilizers all at one time and at different times is briefly reported, the results being inconclusive. Notes and tabulated data are given for experiments with various combinations of potash, phosphoric acid, and nitrogen, in different forms, as in previous years. The results of the experiments thus far made indicate that the soil used does not require potash, but is benefited by the application of nitrogen and phosphoric acid.

Cotton, test of varieties (pp. 494, 495).—Tabulated data of yields of seed and lint are given for 25 varieties. The largest yields of seed and lint were produced by Boyd Prolific, Fishburn, Haggaman, Peerless, Welborn Pet, Bolivar County, and Dickson.

Cotton, experiments with fertilizers (pp. 495, 496).—Experiments similar to those with corn were made, but as the results were inconclusive details are not given.

Sugar cane analyses, B. B. ROSS (*Louisiana Sta. Bul. No. 17, 2d ser., p. 496*).—Tabulated analyses of 11 foreign varieties which are being tested at the Louisiana State Station. The results as compared with those of previous analyses indicate an increase in the amount of sucrose as these varieties become acclimated.

Field experiments with wheat, W. C. LATTA (*Indiana Sta. Bul. No. 41, Aug., 1892, pp. 83–100*).

Synopsis.—A report on experiments under the following heads: (1) Test of varieties, (2) quantity of seed per acre, (3) early and late seeding, (4) rotation *vs.* continuous grain-cropping, (5) commercial fertilizers and horse manure, (6) treatment of seed for loose and stinking smut, (7) effect of change of soil on yield of wheat, (8) early *vs.* late harvesting, and (9) mowing wheat in the spring. The work on the first five subjects was in continuation of that reported in Bulletin No. 36 of the station (E. S. R., vol. III, p. 510). The average results in these lines favor (1) Velvet Chaff and Michigan Amber varieties, (2) 6 to 8 pecks of seed per acre, (3) sowing about September 20 rather than later, (4) rotation of grain and grass. Fertilizers have not been profitable, except on much-worn soils. Neither hot water nor copper sulphate destroyed the germs of loose smut, but both treatments were effectively used for stinking smut. Mowing wheat in the spring materially reduced the yield of grain and straw. The other experiments (8 and 9) gave indecisive results.

Test of varieties.—Tabulated data for 32 varieties tested in 1892, with the average yields of these varieties during one to nine years. In 1891 the most productive varieties were Jones Winter Fife, Red Clawson (extra selected), Early Red Clawson, Velvet Chaff, Michigan Amber, Jones American Bronze, Wyandotte, and Willits. Of these, Michigan Amber and Wyandotte were least affected by rust. Velvet Chaff and Michigan Amber have given large yields during nine years. The latter variety seems to be less liable to injury by rust. Among the varieties recently introduced Red Clawson and Jones Winter Fife are most promising.

Quantity of seed per acre.—Tabulated data are given for the yields of wheat seeded at rates varying from 2 to 8 pecks per acre during eight years (1885–'92). The average yield for the eight years has been from 22.5 to 30.9 bushels per acre, increasing with increased thickness of seeding. The increase from sowing more than 6 pecks is relatively small.

Early and late seeding.—Tabulated data are given for the yield of wheat sown in four years (1889–'92) at different dates from September 18 to October 18. The average results strongly favor the September sowings. The falling off in yield increases in a marked degree toward the close of the season.

Rotation vs. continuous grain-cropping.—The average yields in bushels per acre of all the wheat plats of each series for six years (1887–'92) were as follows: Grass and grain 22.4, grain alone 16.3, grain from rotation 6.1. The tendency is toward an increasing difference in yield in favor of the rotation series.

Commercial fertilizers and horse manure.—Notes and tabulated data for an experiment in 1892 on three series of plats, in continuation of similar work in the two previous years. The results vary considerably, according to the difference in the character of the soil. On worn soil the fertilizers were used with profit, but on more fertile soils they were unprofitable. The average results of the three years' experiments on five series of plats are given in the following table:

Average yield of wheat per acre during three years and financial results.

No. of plat.	Fertilizers.	Pounds fertilizer.	Average yield.		Increased yield.		Net profit or loss.
			Grain.	Straw.	Grain.	Straw.	
			Bush.	*Lbs.*	*Bush.*	*Lbs.*	
1	Nothing		26.7	2,813			
	Dissolved boneblack	138					
	Sulphate of ammonia	181					
2	Muriate of potash	53	32.3	4,279	6.4	1,509	—$2.87*
	Dissolved boneblack	115					
	Sulphate of ammonia	134					
3	Muriate of potash	38	31.4	3,971	5.4	1,201	—1.35
4	Nothing		25.1	2,727			
5	Horse manure	9,250	30.3	3,699	5.1	889	0.79
6	Horse manure	7,650	28.8	3,361	3.6	551	—0.12
7	Nothing		25.2	2,894			

* The minus sign (—) indicates a loss.

Treatment of seed for loose and stinking smut.—Notes and tabulated data on experiments in which seed wheat was immersed in copper sulphate solution (1 pound to 4 gallons of water) for ten minutes or in hot water (133°–160° F. for loose smut and 131°–142° for stinking smut) for five minutes. Neither the hot water nor the copper sulphate materially reduced the amount of loose smut. Treatment with water heated to from 133° to 150° F. somewhat increased the yield of wheat. Seed immersed in water at 154°–160° F. failed to germinate. Both treatments effectually prevented the development of stinking smut, but the copper sulphate reduced the yield of wheat.

Effect of change of soil on yield of wheat.—Seed of the Velvet Chaff variety grown at the station for seven consecutive years was sent in 1890 to four different counties of Indiana, and the seed received from the crop grown in these localities was planted at the station in 1891 alongside of seed of the same variety grown there for eight years. The tabulated results show only slight variations in the yield of the wheat from the different localities.

Early vs. late harvesting.—Wheat harvested June 28, 1892, yielded about the same amount of grain and more straw than that harvested July 2. The weather during this period was cool and cloudy.

Mowing wheat in the spring.—Notes and tabulated data on an experiment in which the wheat on 2 plats was mown April 26, when the plants were about 6 inches high. As a result the growth of the wheat was retarded and the yields of grain and straw were considerably reduced.

Forms of nitrogen for wheat, H. A. HUSTON (*Indiana Sta. Bul. No. 41, Aug., 1892, pp. 100–102*).—Notes and tabulated data for an experiment in continuation of that reported in Bulletin No. 36 of the station (E. S. R., vol. III, p. 512). Nitrate of soda, dried blood, and sulphate of ammonia were each applied in the fall or spring or in both seasons. Sulphate of ammonia gave the greatest increase in 1892, but the best results were obtained the previous season with nitrate of soda. This year there was a greater rainfall and the grain was badly affected by rust. The work in this line will be continued.

Field experiments with wheat and oats (*Kentucky Sta. Bul. No. 42, Sept., 1892, pp. 16*).

Synopsis.—A report on experiments in 1892 with wheat and oats in continuation of those recorded in Bulletin No. 35 of the station (E. S. R., vol. III, p. 227). The experiments with wheat include a test of varieties, deep *vs.* shallow planting, thick *vs.* thin seeding, and a test of fertilizers. Varieties of oats were also tested. During four years (1889–'92) Egyptian, German Emperor, and Hunter White varieties of wheat have given the highest average yield. During the same period the most productive varieties of oats have been Early Dakota, Welch, White Victoria, White Canadian, and Barley. On the soil of the station farm fertilizers have had very little effect on the yield of wheat.

Wheat, test of varieties (pp. 3–8).—Tabulated data are given for 33 varieties tested in 1892, 19 of which yielded over 20 bushels per acre. The following table gives the yield in four different years (1889–'92) for those varieties which have given an average yield of over 20 bushels per acre:

Yield of wheat per acre during four years.

Name of variety.	1889.	1890.	1891.	1892.	Average.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*
High-Grade	17.0	20.2	27.0	32.4	24.2
Egyptian	30.5	19.5	33.5	30.7	28.6
Mealy	16.7	18.0	26.0	30.4	22.8
German Emperor	30.5	24.7	26.2	27.5	27.2
Penquite Velvet Chaff	....	20.8	23.2	27.2	23.7
Hunter White	27.0	24.8	31.0	25.5	27.1
New Genesee	....	24.8	27.0	24.0	25.3
Early Red Clawson	....	21.5	29.0	23.2	24.3
Jones Winter Fife	....	....	30.7	22.8	26.8
Red Wonder	....	....	....	22.8	....
Rudy	....	22.5	32.0	22.4	25.6
Martin Amber	22.5	24.0	26.0	21.6	23.2
Canadian Velvet Chaff	....	....	30 0	21.4	25.7
Golden Amber	21.0	20.2	28.0	21.2	22.6
Fulcaster	23.4	23.2	26.5	20.8	23.2
Improved Fultz	....	....	....	20.8	....
Red Russian	....	....	....	20.8	....
Valley	....	....	....	20.4	....
Royal Australian	....	....	30.8	20.2	25.6
Extra Early Oakley	....	....	21.8	20.0	20.9
Buckeye	17.0	21.3	30.0	18.8	20.2
Hicks	19.1	17.2	28.5	18.4	20.8
Silver Chaff	....	....	28.5	17.2	22.8
Canadian Finley	26.0	17.0	32.0	12.6	21.9

Wheat, deep vs. shallow planting and thick vs. thin seeding (p. 8).—Tabulated data are given for an experiment in which wheat was sown in drills on 4 plats at depths of from 1 to 4 inches and on 5 plats at rates of from ½ to 2 bushels of seed per acre. The depth of the drills seemed to make little difference in the yield, but in general the yield increased with the amount of seed used.

Wheat, test of fertilizers (pp. 8–14).—"Acid black" 320 pounds per acre, muriate of potash 160 pounds, and dried blood 160 pounds, singly, two by two, and all three together, as compared with no manure, were applied to Fultz wheat on 10 tenth-acre plats in the fall of 1891, and in the following spring additional fertilizers were applied on one half of each previously fertilized plat. The results agree with those of previous years in showing that fertilizers have little effect on the yield of wheat on the soil of the station farm. The spring application of fertilizers, especially nitrate of soda, produced a ranker and greener growth of the plants, but, except on 1 plat, did not materially increase the yield.

Oats, test of varieties (pp. 15, 16).—Tabulated data are given for 21 varieties tested in 1892. The following table shows the comparative yield of a number of varieties tested at the station during four years.

Yield of oats per acre during four years.

Name of variety.	1889.	1890.	1891.	1892.	Average.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Welch	43.0	14.0	32.3	34.4	30.9
Badger Queen	....	....	....	34.4	....
Barley	27.0	19.6	35.0	33.1	28.7
Race Horse	....	....	....	33.1	....
Early Dakota	44.0	22.5	35.0	31.9	33.4
White Canadian	38 0	17.0	33.8	30.0	29.7
American Banner	....	....	....	30.0	....
Black Tartarian	37.0	17 0	30.5	29 4	28.5
White Victoria	46.5	14.0	32.3	29 0	30.4
Monarch	43.0	12.6	32.3	26 9	78.7
Welcome	46 0	17.0	26.8	25 0	28.1
Haggett White Seizure	40.0	14.0	36.0	23.8	28.4

Field experiments with wheat, J. F. HICKMAN (*Ohio Sta. Bul. No. 42, August, 1892, pp. 83–98*).

Synopsis.—A report on experiments and observations in the following lines: (1) Methods of seeding, (2) wheat grown after melilotus, (3) shrinkage in the granary, (4) degeneration of varieties, (5) test of varieties, (6) diseases of wheat. A part of the work was in continuation of that reported in Bulletin vol. IV, No. 4, of the station (E. S. R., vol. III, p. 243). The results favor drilling as compared with sowing broadcast, and growing wheat after melilotus rather than in rotation with other grain. Cross-drilling was of some advantage in 1892, but not in 1891. The amount of shrinkage in storing wheat varied with different varieties and with the dryness of the season. Grain from first-grade seed weighed more per measured bushel than that from second-grade seed. None of the newer varieties tested did any better than a number of the older varieties. The percentage of protein in different varieties ranged from 10.63 to 16.66. Loose and stinking smuts did little damage in 1892. Scab was injurious to most of the varieties, especially to those ripening late. During two years seeding a mixture of 2 varieties has not increased the yield.

Methods of seeding.—The results from drilling seed at depths of from 1 to 4 inches as compared with those from sowing broadcast were very favorable to drilling in 1892. The ground was very dry at time of planting. The average results for four seasons also favor drilling. Cross-drilling this season has given better results than drilling one way. The roller following after each hoe of the drill has not added materially to the yield of grain. A mixture of the seed of 2 varieties has not increased the yield in 1891 or 1892.

Ordinary barnyard manure was compared with the same saturated with cow urine from a tank in the stable. The liquid manure increased the yield of straw, but somewhat at the expense of the grain yield.

Wheat grown after melilotus.—Poole wheat was sown in the fall of 1891 on a piece of very poor clay land on which *Melilotus alba* had been grown since July, 1888. The same variety was also sown on adjoining land which had been in corn, oats, and wheat in previous years. The yield on the former plat was 26.9 bushels per acre, and on the latter plat 18.6 bushels.

Shrinkage in the granary.—Notes and tabulated data for an experiment in which samples of some 20 varieties of wheat were put in small wooden boxes and buried in a bin of wheat, where they remained about a year. "They were then left in one corner of the bin without any covering until August 5, 1892, when it was found that 6 out of the 20 varieties had been injured by insects, so that only 14 of them were in condition to be weighed." Four sides of the boxes "were made of half inch pine boards thoroughly seasoned, the bottom was of window-screen wire, and the top of glass." It was found that the amount of shrinkage varied considerably with the different varieties, ranging from 0 to 4.94 and averaging 2.32 per cent. Another experiment in which bushel samples of wheat were kept in bags in a bin from January to July in a wet season (1892), is briefly reported. In this case the samples "aggregated a few pounds more in July than in January."

Degeneration of varieties.—Notes and tabulated data for the first of a series of experiments in which the yields of ordinary and selected seed of different varieties are to be compared. The different grades of the 3 varieties tested in 1892 showed only slight variations in yield, but the weight per measured bushel distinctly favored the first-grade seed.

In this connection attention is called to the fact that we have 2 varieties at this station, the Velvet Chaff (Penquite) and Silver Chaff (smooth), that have been grown upon this farm continuously, without change of seed, for twelve years. The Velvet Chaff has given an average yield, in periods of three years each, as follows: The first period 25.8 bushels, the second 37 bushels, the third 35.1 bushels, and the fourth or last period 29.4 bushels per acre. The Silver Chaff for the same periods has given the following yield: The first period an average of 29.1 bushels, the second 41.3 bushels, the third 33 bushels, and the last period 28.35 bushels per acre. * * *

The Democrat, a white, smooth variety, raised nine years, follows the same general tendency—high the first three years, lower the second, and higher again the last three years. German Emperor, grown six years in succession without change

of seed, has averaged as high the last three years as it did the first three. Red Brazilian and Witter, each grown six years, show a considerably lower average yield for the last three years than for the first three, the average per acre during the last three years being 4 bushels less in each case.

Test of varieties.—Tabulated data for 75 varieties tested in 1892 and average yield of grain and straw for five years in case the variety has been tested so long a time. The percentage of protein in the grain of each variety is also given, as determined by the station chemist. The following varieties gave the largest yields this year: Valley (Reliable), Diehl-Mediterranean (Golden Cross), American Bronze, Tuscan Island, Fultz (Rocky Mountain), Gypsy, Early Red Clawson, Jones Winter Fife, Jones Square Head, Rudy, and Hindostan. The percentages of protein range from 10.63 to 16.66. The following table gives the comparative yield of 16 of the most reliable varieties grown at the station during eight years:

Comparative yield of varieties of wheat for eight years.

[Bushels per acre.]

Variety.	1884.	1886.	1887.	1888.	1889	1890.	1891.	1892.	Average.
Valley	38.1	45.8	34.9	33.6	44.5	36.1	39.5	32.2	38.1
Red Fultz	38.2	54.0	35.2	30.9	37.3	32.5	32.4	27.0	35.9
Egyptian	30.6	41.7	28.0	32.2	46.1	34.0	37.2	31.3	35.1
Diehl-Mediterranean	39.2	42.7	26.9	34.1	42.0	27.5	37.6	29 6	34.9
Nigger	36.6	51.0	24.6	32.0	40.6	31.7	31.6	30.0	34.7
Royal Australian	40.2	49.6	38.8	18.1	45.6	32.6	24.5	27.5	34.6
Poole	32.6	61 2	25.5	17.5	43.6	29 6	35.9	30.0	34.4
Tasmanian Red	49.6	45.6	22.1	25.0	37.1	29 3	33.1	29.6	33.9
Penquite Velvet Chaff	33.3	42.9	37.4	26.6	41.3	35 2	27.9	25.4	33.7
Silver Chaff (smooth)	39.7	45.2	30.0	31.4	37.8	29.5	30.1	25.4	33.6
Democrat	35.9	40 4	24.5	25.0	45.3	30.4	38.1	29.5	33.6
Martin Amber	45.2	36.7	21.4	28 2	47.8	29.1	28.8	25 1	32.8
Fultz	36.7	38 4	....	23.1	30.1	34 2	35 6	30 4	32.6
Theiss	29.4	46 2	29.5	36.8	37.8	25.4	30 5	23 3	32.3
Landreth	31.6	39 9	32.0	25.6	41.1	....	25.3	23.7	31.3
Mediterranean	31.0	38 7	22.3	28.2	36.8	29.3	34.5	28.3	31.1
Mean	37.2	45 0	28.9	28.0	40.9	31.9	32.7	28.0	33.9

Diseases.—Stinking smut was present in almost every variety of wheat grown, but not sufficient in any one to do material injury to the crop of this year.

Loose smut damaged the Hicks (and its synonym, Hickman) wheat at least 8 per cent; other varieties very little.

The scab damaged later varieties of wheat most, and did greater injury to the earlier-ripening wheats where the ground was poorly prepared or imperfectly drained, causing them to ripen later than they would under favorable conditions.

Tests of varieties of wheat, D. O. NOURSE (*Virginia Sta. Bul. No. 19, August, 1892, pp. 79–84*).—Notes and tabulated data for 20 varieties tested at the station during two years. The two French varieties, De Rieta and Richelle de Naples, have not been successfully grown. The author hopes, however, to bring about different results by selection of individual plants. The following is a summary for the 10 most productive varieties:

Wheat, test of varieties.

Variety.	1891. Grain.		1892. Grain.		1892. Straw and chaff.	Average grain.		Bearded or smooth.	Color.	Season.	Berry.
	Bush.	*Lbs.*	*Bush.*	*Lbs.*	*Lbs.*	*Bush.*	*Lbs.*				
Tuscan Island.	22	40	30	.....	2,320	26	20	Bearded ..	Red....	Medium.	Long
Fulcaster	23	30	28	34	2,638	26	2	....do	...do ...	....do ...	Short
Tasmanian Red.	24	40	26	14	2,335	25	27	....do	...do ...	....do ...	Long
Fultz......	23	20	27	23	2,447	25	22	Smooth ...	Amber.	....do ...	Short
Poole	21	3	29	7	4,242	25	5	....do	.. do ...	....do ...	Do.
Democrat	20	10	29	8	2,975	24	39	Bearded ..	White .	....do ...	Do.
Wyandotte Red.	21	10	27	32	2,468	24	21	Smooth ...	Red....	Early ...	Do.
Valley	23	20	24	40	1,693	24	.....	Bearded ..	Amber.	Medium.	Do.
Seneca Chief . ..	18	20	26	53	2,662	22	37	....do	...do ...	....do ...	Do.
Lancaster	16	10	28	7	2,931	22	9	....do	Red....	....do ...	Long

Experiments with field crops (*Colorado Sta. Report for 1891, pp. 8–16, 104–121*).—Brief accounts of experiments with sugar beets, barley, oats, buckwheat, millet, wheat, rye, corn, sorghum, beets, turnips, flax, grasses, potatoes, and broom corn at the station and at the Arkansas Valley and Divide Substations.

Experiments in rotation of crops, D. N. BARROW (*Louisiana Stas. Bul. No. 17, 2d ser., p. 497*).—Notes and tabulated data on an experiment at the State Station in which cotton, corn, and oats and peas have been grown in rotation on fertilized and unfertilized plats during four years. Differences in the location and soil of the different plats rendered the results unsatisfactory.

HORTICULTURE.

A. C. TRUE, *Editor.*

Analyses of oranges, J. M. PICKELL and J. J. EARLE (*Florida Sta. Bul. No. 17, 1892, pp. 3–11*).—This is a preliminary report on investigations planned to cover the following points: Chemical composition of the orange as a whole, with reference particularly to quantity of fertilizers extracted from the soil; composition of separate parts (peel, seed, pulp, and juice); percentage of peel, seed, pulp, and juice; percentage of sugar and acid in juice; and average weight, specific gravity, and keeping quality of each variety.

The exhaustion of the soil by oranges is discussed, and tables show the chemical composition, weight, and specific gravity of some of the leading varieties grown in Florida. The more important data are given in the following tables:

Physical analyses of oranges of different varieties.

	Weight of one orange.	Peel.	Seed.	Pulp and juice.
	Grams.	*Per cent.*	*Per cent.*	*Per cent.*
Majorica	209.09	22.24	1.11	76.65
Jaffa	212.12	23.49	0.76	76.74
Navels	217.11	25.65	0.77	73.58
Maltese Blood	187.27	23.92	0.95	75.13
Imperial Malta	191.00	17.30	1.24	81.45
Double Imperial	188.92	24.23	0.43	75.34
Indian River	215.41	18.10	2.35	79.54
Foundling (Indian River)	197.23	18.49	2.75	78.75
Bitter Sweet	194.28	41.36	3.54	55.10
Sour	218.67	41.73	6.30	51.96
Columbia County	212.46	29.16	2.71	68.12
Tangerines	128.81	23.00	1.77	75.22
Mandarins	150.07	24.45	3.62	71.93
Sprack	172.00	18.85	2.89	78.74
Select	73.46	15.37	0.17	84.37
Average	184.51	24.49	2.09	73.50

Chemical analyses of oranges of different varieties.

	Moisture.	Nitrogen.	Organic matter.*	Silica.	Sulphuric acid.	Phosphoric acid.	Ferric oxide.	Lime.	Magnesia.	Potash.	Soda.	Chlorine.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Jaffa	87.46	0.081	11.54	0.018	0.051	0.078	0.003	0.164	0.046	0.504	0.043	0.009
Navels	87.05	0.085	11.70	0.024	0.054	0.094	0.005	0.277	0.040	0.590	0.046	0.012
Maltese Blood	86.90	0.100	11.84	0.008	0.056	0.095	0.004	0.226	0.048	0.650	0.047	0.013
Imperial Malta	86.63	0.109	12.02	0.001	0.065	0.116	0.012	0.228	0.059	0.680	0.056	0.015
Double Imperial	88.62	0.083	10.25	0.001	0.056	0.088	0.011	0.243	0.041	0.571	0.028	0.008
Indian River	88.20	0.112	11.00	0.004	0.024	0.058	0.004	0.219	0.036	0.296	0.022	0.010
Foundling (Indian River)	87.06	0.097	11.69	0.022	0.039	0.097	0.002	0.362	0.060	0.499	0.047	0.018
Bitter Sweet	87.72	0.173	11.12	0.008	0.048	0.080	0.006	0.237	0.054	0.493	0.042	0.007
Sour	86.82	0.203	12.25	0.006	0.023	0.056	0.004	0.236	0.035	0.284	0.026	0.004
Columbia County	86.82	0.176	12.12	0.010	0.035	0.082	0.008	0.142	0.056	0.486	0.044	0.016
Tangerines	89.47	0.161	9.70	0.008	0.046	0.051	0.009	0.096	0.042	0.380	0.037	0.011
Mandarins	89.80	0.111	9.59	0.008	0.026	0.048	0.004	0.064	0.021	0.289	0.023	0.008
Sprack† / Select‡	89.63	0.136	9.64	0.008	0.036	0.049	0.006	0.080	0.031	0.334	0.030	0.009
Average	87.71	0.124	11.24	0.010	0.042	0.077	0.006	0.207	0.045	0.479	0.039	0.011

* Exclusive of nitrogen. † Mandarin. ‡ Tangerine.

Fertilizing ingredients in 1,000 oranges.

	Silica.	Sulphuric acid.	Phosphoric acid.	Ferric oxide.	Lime.	Magnesia.	Potash.	Soda.	Chlorine.	Nitrogen.
	Ounces.	*Ounces.*	*Ounces.*	*Ounces.*	*Ounces.*	*Ounces.*	*Ounces.*	*Ounces.*	*Ounces.*	*Ounces.*
Jaffa	1.50	3.80	6.10	0.23	12.00	3.78	37.00	3.03	0.75	6.10
Navels	1.55	3.90	7.10	0.39	21.70	3.10	46.50	3.87	0.77	6.20
Maltese Blood	0.67	3.70	6.30	0.28	14.90	3.34	43.50	3.34	0.67	6.60
Imperial Malta	0.07	4.30	7.80	0.67	15.30	4.09	45.80	4.09	1.02	7.30
Double Imperial	0.05	3.10	5.90	0.74	16.20	2.70	38.10	2.02	0.54	5.50
Indian River	0.31	1.80	4.40	0.31	16.60	3.07	22.50	1.53	0.77	8.50
Foundling (Indian River)	1.41	2.70	6.70	0.14	25.20	4.23	34.70	3.52	1.41	6.70
Bitter Sweet	0.55	3.30	5.50	0.41	16.20	3.46	33.80	2.77	0.48	11.80
Sour	0.47	1.80	4.30	0.31	18.20	3.04	38.00	3.04	0.31	15.60
Columbia County	0.76	2.60	6.10	0.01	10.60	4.54	36.40	3.03	1.51	13.20
Tangerines	0.37	2.10	2.30	0.46	4.40	1.84	17.20	1.84	0.46	7.30
Mandarins	0.43	1.30	2.50	0.21	3.40	1.07	15.30	1.07	0.43	5.80
Sprack* / Select†	0.40	1.70	2.40	0.33	3.90	1.45	16.25	1.45	0.44	6.55
Average	0.68	2.86	5.42	0.39	14.56	3.19	34.07	2.76	0.76	8.38

* Mandarin. † Tangerine.

Different oranges of the same species often differ very considerably in composition. For example, the ash of the Navel as grown and analyzed in California shows 47.5 to 55.3 per cent potash, 16.4 to 26.4 per cent lime, 9.8 to 14.2 per cent phosphoric acid, and 4.2 to 7.9 per cent sulphuric acid. This difference is due to a great extent no doubt to difference in soil, fertilization, climate, etc. But it is a question if oranges from different parts of the same tree might not differ in composition. It is also a question whether or not different species, if grown under uniform conditions of soil, fertilization, climate, etc., would exhibit characteristic differences in the proportions of ash constituents. Our analyses of the ashes give sulphuric acid 3.3 to 6.8 per cent, average 4.86 per cent; phosphoric acid 7.5 to 9.8 per cent, average 8.6 per cent; lime 13 to 32 per cent, average 22.77 per cent; potash 42 to 59 per cent, average 52 per cent; magnesia 3.5 to 6.4 per cent, average 5 per cent; soda 2.8 to 5.5 per cent, average 4.26 per cent. * * *

Taking average analyses as a basis, a fertilizer which is to restore to the soil the plant food removed by the orange should be composed as follows:

	Florida.	California.
Phosphoric acid, parts by weight	1.0	1.0
Nitrogen, parts by weight	1.6	3.4
Potash, parts by weight	6.0	4.0

A fertilizer which would return to the soil the constituents extracted by the orange should contain about 2.7 per cent phosphoric acid, 4 per cent nitrogen, and 16 per cent potash.

Determinations of the specific gravity of oranges when freshly pulled and after being kept different lengths of time showed that the specific gravity of a freshly pulled orange is usually less than unity, but as drying out goes on it generally increases for a while, until it exceeds unity, then decreases.

On the comparative merits of steam and hot water for greenhouse heating, F. W. CARD (*New York Cornell Sta. Bul. No. 41, Aug., 1892, pp. 107–130, figs. 2*).—This article, with an introduction by L. H. Bailey, contains a detailed account and tabulated data of an experiment conducted during January and February, 1892, in two series of forcing houses at the station, one series being heated with steam and the other with hot water.

The various character of these houses necessitates many elbows and fittings in the piping and the fall is slight. These are conditions to which water is not adapted, but as these are the conditions which are usually present in commercial establishments, our results must have an intensely practical bearing. Steam overcomes difficulties much more readily than hot water. Our hot-water system is put in after the most approved fashion, and the following tests concern the actual merits of the two systems under practical conditions. In perfectly straight and simple runs the results might be very different.

The points considered were, the temperature of the pipes, radiation of heat from the pipes, distribution of heat in the pipes, coal consumption, and the influence of pressure upon the temperature of steam pipes. The plan of the forcing houses and of the systems of heating employed is described and illustrated. Brief accounts of experiments elsewhere are given, with references to the literature of this subject. Experiments in this line were reported in Bulletins Nos. 4, 6, and 8 of the Massachusetts Hatch Station, and in Bulletin No. 63 of the Michigan Station (E. S. R., vol. I, pp. 82, 225; II, pp. 104, 236).

The results of the experiment, which, the author is careful to state, are to be considered with reference to the conditions of the test, are given in the bulletin in the following paragraphs:

(1) The temperatures of steam pipes averaged higher than those of hot-water pipes throughout the entire circuit for the entire period of test.

(2) The higher the inside temperature in steam pipes the less is the proportionate warming power of the pipes at a given point. The heat is distributed over a greater length of pipe, and as steam is ordinarily carried at a higher temperature than hot water, it has a distinct advantage for heating long runs.

(3) When no pressure is indicated by the steam gauge, the difference between the temperature of the riser and the return is greater with steam than with hot water.

(4) Under pressure, the difference is less with steam than with hot water.

(5) There is less loss of heat in the steam risers than in the hot-water risers, and this means that more heat, in the steam system, is carried to the farther end of the house and more is spent in the returns as bottom heat.

(6) This relation is more uniform in the steam risers than in the hot-water risers, giving much more even results with steam than with hot water.

(7) When the fires are operative the fluctuation in the temperature of the risers at any given point is much greater with hot water than with steam.

(8) An increase in steam pressure raises the temperature of the entire circuit, but the temperature does not rise uniformly with the pressure.

(9) The first application of the pressure increases the temperature of the returns much more than that of the risers.

(10) Steam is better than hot water for long and crooked circuits.

(11) Pressure is of great utility in increasing the rapidity of circulation of steam and in forcing it through long circuits and over obstacles.

(12) Unfavorable conditions can be more readily overcome with steam than with hot water.

(13) Hot water consumed more coal than steam, and was at the same time less efficient. This result would probably be modified in a shorter and straighter circuit with greater fall.

(14) Under the conditions here present steam is more economical than hot water and more satisfactory in every way, and this result is not modified to any extent by the style of heaters used.

Second report on electro-horticulture, L. H. BAILEY (*New York Cornell Sta. Bul. No. 42, Sept., 1892, pp. 133–146, figs. 4*).

Synopsis.—A report on work in continuation of that recorded in Bulletin No. 30 of the station (E. S. R., vol. III, p. 232). In the experiments reported in this article an arc light with a clear glass globe was hung above the greenhouse. Lettuce was greatly benefited by the light; radishes, beets, and spinach were somewhat benefited; cauliflowers tended to grow taller, and make fewer and smaller heads; violets and daisies bloomed earlier; with endives the results were negative. The electric light did not appear to determine or modify the periods of growth of lettuce.

In the experiments reported in this bulletin an electric street lamp was suspended outside in the valley between the parallel greenhouses. The lamp was hung in front of a large blackened sheet-iron screen, which, in connection with the partition in the house and a series of curtains, completely excluded the light from the compartment behind the lamp. By moving the screen to the other side of the lamp and rearranging the curtains, we were able to throw all the light into the other compartment; this change was made during the experiment. The lamp is the same pattern as that used the previous winter—a 10 ampere 45-volt

2,000 nominal candle power Westinghouse alternating current lamp. The lamp was attached to an ordinary street-lighting system, and it seldom burned after 11 o'clock, while it often ran but an hour or two, and on moonlight nights not at all. The lighted house was exposed to sunlight during the day, and in addition received this small and varying amount of electric light. The other, or so-called dark house, was lighted by sun during the day and received no light at night. The lamp carried a clear glass globe, so that the light passed through two planes of glass, in the globe and the roof, before reaching the plants.

The house used in the experiments reported in detail was the one in which the experiments of the previous year were conducted. In the other house tomatoes, cucumbers, and beans were grown, but no influence of the electric light on these plants was observed, and therefore no details of the experiments are given.

Notes and tabulated data are given for experiments with lettuce, endives, radishes, beets, spinach, cauliflowers, violets, and daisies. The electric light was started October 15, 1891.

Lettuce.—On October 15, plants of the Boston Market variety, four weeks old, were transplanted to the bench nearest the light. Very soon the plants in the light compartment, especially those nearest the light, began to improve, and at the end of the first week were perceptibly ahead of those in the dark compartment. "The plants, even to the farthest extremity of the light compartment, gained steadily throughout the experiment, and they were ready for market from a week to ten days earlier than in the dark house. In quality and all other characters this lettuce was indistinguishable from that grown under normal conditions."

Seedlings of the Landreth Forcing variety on a bench farther from the light were stunted for the first week or ten days of their growth, and though they afterwards recuperated rapidly were never superior to their companions in the dark compartment.

Lettuce was also transplanted into the highest bench, in order to determine how far the influence of the light extends. The extremity of the light compartment was 40 feet distant from the lamp and the roof was so low that much of the light was reflected; yet at this distance, where there was only diffused light, the plants at a month after the light started were much better than in the dark house.

The experiment was repeated with second and third crops of lettuce with similar results, and with several varieties. February 9, Simpson lettuce was transplanted upon the lowest bench and the customary increase under the light took place. March 22, when the lettuce was nearly large enough for market, the light was transferred to house B, and thereafter the poorer plants received the light. These poorer plants soon showed the effect of the new conditions and the time between the maturity of the two crops was considerably lessened.

Perhaps the best illustration which we found of the influence of the light upon lettuce was afforded by a crop upon the highest bench, into which radishes were also planted. The interception of the light by the radish leaves had a most marked effect upon the lettuce plants which stood behind them, the adjacent plants which chanced to be exposed to the full light being much larger. The bench, therefore, presented a very uneven appearance when the radishes were removed, and the shadows from the radish leaves could be traced in the lettuce. Similar results were observed where the dense shade of a rafter lay across the plants.

Endives.—Plants five weeks old, transplanted November 11, grew very much alike in the two compartments.

Radishes.—Tabulated data are given for the yield of radishes (entire plant, tops, and tubers) of 12 varieties grown on three different benches between young lettuce plants.

The plants in the light house were ahead in every feature. It will also be noticed that the proportion of tops to the entire plant is greater in the light than in the dark house, the difference being that between 55 and 49 per cent. All these results are interesting when compared with our former experience, for they show how much the simple interposition of plain glass may modify the influence of the light. In 1890, under the naked light radishes were uniformly injured, the loss ranging from 45 to 65 per cent; the same year, under a light protected by an opal globe the injury was still apparent; the loss in tubers was only from 1 to 5 per cent of the crop, but at the same time the weight of leaves was increased; now this year, under light strained through a globe and a glass roof there was an increase in both tubers and tops. In no case, however, have radishes been sufficiently benefited to pay the cost of the light; but our results seem to show that a well-protected light is some assistance to them.

Beets.—Plants from seed of the Early Egyptian variety sown in the greenhouse October 15 grew more vigorously in the light compartment.

Five months after sowing the beets were removed, when it was found that 57 per cent of the plants in the light house gave marketable tubers against only 33 per cent of those in the dark house; and the total average weight of the plants in the light house was about half an ounce greater than in the dark house. It must be said, however, that the test with beets was hardly a fair one from the fact that the plants in the dark house received more bottom heat than the others, but as the results corroborate those obtained from radishes the figures may possess value.

Spinach.—Plants of the Round Dutch variety transplanted into both compartments October 15 grew more rapidly in the light compartment throughout the experiment.

Cauliflowers.—January 8, a dozen plants 4 inches high were planted in 6-inch pots in each of the compartments. "The plants in the light house were 10 feet from the lamp and almost under it." The plants in the dark compartment made a more stocky growth and formed heads earlier. When the plants were cut, February 29, the heads from the dark house had a greater average size and weight.

Violets.—Strong plants of the Marie Louise variety were set in the light compartment a few days before the light started. Each night half of the bed was covered with a black enamel cloth box. Three weeks after the light started the exposed plants began to bloom, and continued to do so for two weeks before a flower appeared on the darkened plants. At this point the appearance of blight terminated the experiment.

Daisies.—" Fifty strong plants of the low daisy (*Bellis perennis*) were divided between the two houses. Those in the light compartment were from 15 to 18 feet from the lamp, in rather weak light. The first bloom appeared just four weeks after the starting of the light, and it was in the light house. For a month or six weeks thereafter the lighted

plants bloomed more profusely, but at that time the dark-house plants began to surpass the others both in number and size of flowers and vigor of plants."

Period of plant growth.—Tabulated auxanometer measurements are given showing the growth of a single lettuce leaf during four consecutive days (April 1–4) in each compartment.

The figures plainly show (1) that the electric light did not determine the periodicity of growth, (2) that increase under the light occurred only during the first days, and (3) that growth in both houses took place in daylight as well as in darkness. The conclusions suggested by this short record I believe to be generally true of lettuce when grown under the conditions here present.

Strawberries (*New York State Sta. Bul. No. 44, n. ser., Aug., 1892, pp. 139–147*).—Brief descriptive notes on 23 of the newer varieties of strawberries tested at the station, tabulated data for 103 varieties, and a list of 62 varieties planted in the spring of 1892. The 20 most productive varieties in the order named are, Beder Wood, Greenville, Burts, Enhance, New Dominion, Sov de Bossnet, Lyons Seedling, Farnsworth, Middlefield, Wayfield, Hurlburt, Hampden, Eureka, Phillip Seedling, Daisy, Haverland, Crescent, Governor Hoard, Great Pacific, and Viola.

Plums and peaches, D. N. BARROW (*Louisiana Stas. Bul. No. 17, 2d ser., pp. 498, 499*).—Brief notes on 5 varieties of plums and 10 of peaches in an orchard at the Louisiana State Station.

Experiments with vegetables and fruits (*Colorado Sta. Report for 1891, pp. 17–20, 104–111, 117–119*).—Brief accounts of experiments with varieties of peas, beans, watermelons, cantaloupes, squashes, pumpkins, turnips, beets, cabbages, cauliflowers, tomatoes, celery, sweet potatoes, and radishes at the station and at the Arkansas Valley and Divide Substations. There is also brief mention of tests of orchard and small fruits and grapes.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Smut in oats and wheat, P. M. HARWOOD (*Michigan Sta. Bul. No. 87, Sept., 1892, pp. 10, figs. 5*).—Descriptions of smut on wheat and oats and directions for treatment, largely compiled from Farmers' Bulletin No. 5 of this Department and Bulletin No. 35 of the Indiana Station (E. S. R., vol. II, p. 637). The author recommends the use of the Jensen hot water treatment of the grain before seeding. The loss to the farmers of Michigan in 1892 from smut of oats is estimated at over $1,000,000.

Some troubles of winter tomatoes, L. H. BAILEY (*New York Cornell Sta. Bul. No. 43, Sept., 1892, pp. 149–158, figs. 4*).—This bulletin deals with three diseases of considerable importance to those engaged

in growing tomatoes during the winter, viz, a bacterial disease, the common blight (*Cladosporium fulvum*), and a nematode root gall. The bacterial disease appeared at the station in the winter of 1890–'91 and the first notice was by E. G. Lodemann in *Garden and Forest*, vol. v, p. 175. Most of the investigation has been with reference to means for checking its ravages.

"This blight attacks the leaves. The first indication of the trouble is a dwarfing and slight fading of the leaves and the appearance of more or less ill-defined, yellowish spots or splashes. These spots soon become dark or almost black, the leaf curls and becomes stiff, and the edges draw downward, giving the plant a wilted appearance. The spots grow larger until they often become an eighth of an inch across or even more, and they finally become more or less translucent. This injury to the foliage causes the plants to dwindle, and the stems become small and hard. Fruit production is lessened, or if the disease appears before the flowers are formed no fruit whatever may set. In two or three instances in which young plants were attacked the disease killed the plant outright, but a diseased plant ordinarily lives throughout the winter, a constant disappointment to its owner. * * * The disease is not known to attack the fruit."

Attempts were made to identify this new disease with the bacterial potato blight and the tomato blight described in Bulletin No. 19 of the Mississippi Station (E. S. R., vol. III, p. 702), but Drs. Burrill and Halsted, to whom specimens were sent for examination, say it is distinct. The tomato blight is due to a bacterium, while Prof. W. R. Dudley finds this to be caused by a micrococcus. Diseased plants have been carried over the summer and will be made the subject of critical study during the coming winter. Spraying the plants with ammoniacal carbonate of copper, watering the soil with this or with nitrate of soda or lye, and washing the boxes in which diseased plants had been grown with ammoniacal carbonate of copper, whitewash, Bordeaux mixture, or lye, did not prevent the development of the disease. So far the only method of treatment likely to be effective is the destruction of diseased plants and starting anew with fresh soil and new plants.

The ordinary blight of the tomato was also noticed. This will generally yield to spraying with ammoniacal carbonate of copper if applied early enough.

Nematode galls attack the roots and often the whole root is swollen into a shapeless mass. "The plants become weak and stop growing, and the leaves curl and become dry and yellow, much as if the plant were suffering for water. In general, plants injured by root galls resemble those suffering from winter blight, except that the leaves do not show the spotted discolorations." Five boxes were treated before planting, (1) with lye, (2) with salt, (3) with quicklime, (4) with carbon bisulphide, and (5) frozen solid. In each of these plants were placed, and at the end of six months the plants in all the boxes except Nos. 2 and 5 were infested, but upon these no galls were found. The experiments were too limited to warrant any general conclusions, but it is hoped that means may be found for treating the soil between crops.

Four diseases of the apple, W. B. ALWOOD (*Virginia Sta. Bul. No. 17, June, 1892, pp. 59-66*).—A popular treatise on the rust of the foliage (*Gymnosporangium macropus*), scab of the fruit and foliage (*Fusicladium dendriticum*), bitter rot of the fruit (*Glœosporium fructigenum*), and brown spot of the foliage (*Phyllosticta pirina?*), with directions for their identification and preventive methods of treatment.

ENTOMOLOGY.

Report of entomologist of Maine Station, F. L. HARVEY (*Maine Sta. Report for 1891, pp. 187-207, figs. 13*).—Illustrated notes and correspondence regarding the following insects: Tick (*Ixodes ricinus*), sphinx moths (*Smerinthus geminatus, Treptogon modesta*, and *Sphinx gordius*), climbing cutworm (*Agrotis saucia*), greasy cutworm (*Agrotis ypsilon*), glassy cutworm (*Hadena devastatrix*), cotton dagger (*Apatela lepusculina*), three-toothed aphonus (*Aphonus tridentata*), *Dytiscus verticalis, Elaphidion parallelum, Plinus brunneus*, apple aphis (*Aphis mali*), goldsmith beetle (*Cotalpa lanigera*), and four-spotted mite (*Tetranychus 4-maculatus*).

Notes on insects, J. C. NEAL (*Oklahoma Sta. Bul. No. 3, June, 1892, pp. 20, figs 8*).—Popular notes on the imported cabbage butterfly (*Pieris rapæ*), cabbage plusia (*Plusia brassicæ*), cutworms, bollworm (*Heliothis armigera*), striped melon beetle (*Diabrotica vittata*), gray blister beetle (*Lytta cinerea*), chinch bug (*Blissus leucopterus*), and horn fly (*Hæmatobia serrata*). Formulas for insecticides are also given.

The horn fly in Florida, P. H. ROLFS (*Florida Sta. Bul. No. 17, pp. 12-14, fig. 1*).—Brief compiled notes on *Hæmatobia serrata*, which made its appearance in Florida in 1890 or 1891 and has already caused trouble, especially to milch cows.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Digestibility of green and dry timothy, W. P. CUTTER (*Utah Sta. Bul. No. 16, Aug. 1, 1892, pp. 12*).

Synopsis.—The determination of the coefficients of digestibility of green timothy and timothy hay with steers indicated no appreciable difference in this respect between the two materials.

After popular introductory remarks on the composition and digestibility of feeding stuffs, the author describes an experiment with five steers, to study the digestibility of grass and hay from timothy. The

trial was a part of the experiment with pasturage, soiling, and hay for steers described below. Three steers were fed green and two dried timothy, the trial lasting fifteen days and the excreta being collected during the last five days. The details of the trial, including analyses of the timothy fed and the excreta, are stated in an appendix. The average results are given as follows:

Coefficients of digestibility of green and dried timothy.

	Dry matter.	Crude ash.	Crude cellulose	Crude fat.	Crude protein.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Dried timothy	64.04	31.69	55.75	53.26	48.46	67.84
Green timothy	63.53	32.21	55.62	53.14	48.11	65.75

"(1) There seems to be no appreciable difference in the digestibility of timothy when fed green and when fed after being properly cured.

"(2) The digestibility of the timothy on the station farm seems to be higher than Wolff's standard, agreeing more closely with Jordan's results."

Soiling of steers; green vs. dry food, J. W. SANBORN (*Utah Sta. Bul. No. 15, Aug., 1892, pp. 9*).

Synopsis.—A comparison of pasturage, green grass, and hay from the same for steers during summer. One lot grazed on 2 acres, another received the green grass, and the third the dry hay from similar areas. The gains made per steer were identical for the three lots, but the green-grass lot did not eat all of the grass cut from 2 acres.

The object of this trial was to compare the results of allowing steers to graze on a given area and of feeding the grass cut from a similar area in a green and in a dry state. The trial was made with three lots of three steers each, averaging about 800 pounds live weight. Six acres of land were divided into three equal parts, lot 1 being pastured on one part, lot 2 fed in the barn on the green grass cut from the second part, and lot 3 fed in the barn on the hay made from the third part. The steers were all fed alike for twenty-five days, after which, June 1, the trial began and continued for three months. The grass consisted of a mixture of lucern, timothy, and red clover. Early in the trial the lucern fed to lot 3 was dried only one day and as a result, it is believed, one steer died. Consequently the lucern was dried after this for three days before being fed. The record of the weekly weighings of the animals is tabulated, together with the amounts of grass and hay given to lots 2 and 3, respectively. The gain in live weight per steer was the same for each lot (133¼ to 134⅓ pounds). Lot 2, fed green grass, did not eat all of the grass cut from the 2-acre lot.

The steers that grazed grew no faster, yet ate or disposed of 28 per cent more food than did lot 2 (green grass). * * * The lot receiving dried food ate more than did the lot receiving green food, and it was constantly noted that they ate their food with greater relish than did the other lot. * * *

It appears from this trial that soiling is unnecessary, dry food answering the same purpose; that winter feeding is quite as economical when cattle are fed in stalls or yards as summer feeding in stalls or yards; that grazing is somewhat wasteful; and that green grass and young grass are no more effective than dry and mature grass or hay.

Winter feeding-experiments with lambs, C. A. GOESSMANN (*Massachusetts State Sta. Bul. No. 43, Aug., 1892, pp. 2–8*).

Synopsis.—The results are given of feeding six grade wether lambs for six months on a nitrogenous ration composed of wheat bran, maize feed or gluten feed, rowen, mangel-wurzels, and silage. At the local market prices of feeding stuffs and meat, and making allowance for the value of the manure, the gains made gave only a slight profit—$2.86 for the six animals.

The experiments here reported are in continuation of those with a similar object reported in the Annual Reports for 1890 and 1891 and Bulletin No. 37 of the station (E. S. R., vol. II, p. 231; III, p. 155; IV, p. 67). Six grade wether lambs, averaging about 75 pounds in weight, were fed for a period of one hundred and eighty-three days on rations consisting of wheat bran with maize feed or gluten feed, and rowen alone or with Globe mangel-wurzels or corn silage. The nutritive ratio of the rations ranged at different times from 1:4.79 to 1:5.34. From 5 to 6 ounces of the grain mixture (equal parts by weight of wheat bran and maize feed or gluten feed) were fed per head daily. The lambs were not sheared prior to the experiment. They were bought for 5½ cents per pound live weight, and at the conclusion of the trial were slaughtered and sold at 11 cents per pound dressed weight. The analyses of the feeding stuffs used with reference to both food and fertilizing ingredients, the gains in live weight, the yield of dressed weight and of wool, and the financial results are tabulated. The gains were small, averaging only 17.08 pounds per sheep for the entire six months. In estimating the profit or loss, the feeding stuffs are valued at local market prices, viz, wheat bran $22, maize feed $25, gluten feed $20, rowen $15, mangel-wurzels $4, and silage $2.50 per ton, and 92 per cent of the fertilizing ingredients of the food are assumed to be obtainable in the manure. The total cost of the six lambs and feed was $44.22, and the value of the meat, wool, and manure $47.08, an apparent profit of $2.86.

(1) The average daily increase in live weight as compared with that noticed in the two preceding experiments is not as satisfactory. * * *

(2) The feeding effect of corn silage, when fed with the same kind and amount of grain feed, compares well with that of Globe mangel-wurzel roots.

(3) The market cost of the daily fodder ration above stated is in the majority of cases lower than those used in our preceding experiments with lambs; it varies from 1.65 to 1.93 cents in different feeding periods.

(4) The value of the manure obtainable from the different daily fodder rations varies from 0.78 to 0.98 cent; it amounts to one half of the market cost of the daily diet.

(5) The low market cost of the grain feed during the third experiment as compared with that on preceding occasions, and the high commercial value of the obtainable manurial refuse, due to their rich nitrogenous composition, have secured a small profit.

Effect of cotton seed and cotton-seed meal as food for hogs, G. W. CURTIS and J. W. CARSON (*Texas Sta. Bul. No. 21, June, 1892, pp. 195–208*).

Synopsis.—Two trials are reported which were made to observe the effect of feeding cotton-seed meal, and soaked, boiled, and roasted cotton seed to pigs, and to compare these feeding stuffs with shelled corn. The first experiment contained twenty and the second fifteen pigs, divided into lots and fed continuously for about a month. In each case the lot receiving corn alone made the largest and cheapest gain in live weight. The next best gain was from boiled cotton seed. In the first trial ten and in the second seven pigs died within ten weeks after beginning to feed the cotton seed or cotton-seed meal.

To ascertain the effect of feeding cotton seed or cotton seed meal on the health and growth of pigs, trials were made in 1891 and 1892. In the former case four lots of five pigs each, ranging in weight from 78 to 158 pounds at the beginning of the trial, were fed for a period of thirty days on rations consisting of corn alone, or corn and skim milk with cotton seed meal, boiled cotton seed, or roasted cotton seed. The tabulated results show that the lot receiving corn alone made much the largest gain, while there was little difference between the gains made by the lots receiving cotton seed or meal.

In the trial in 1892, five lots, each containing one large, one medium, and one small grade Essex pig, were fed for thirty-three days, as follows:

Lot 1, corn and cotton-seed meal.
Lot 2, corn and soaked cotton seed.
Lot 3, corn and boiled cotton seed.
Lot 4, corn and roasted cotton seed.
Lot 5, corn alone.

To the first four lots 5 pounds of shelled corn per lot was fed daily and cotton seed or cotton-seed meal *ad libitum*, the amounts of the latter ranging from 3 to 4 pounds per day, and to the fifth lot about 14 pounds of corn per day was fed. Each lot was also given a mixture of ashes, salt, and sulphur. At the beginning of the experiment the large pigs ranged from 108 to 141 pounds in weight, the medium from 77 to 94 pounds, and the small from 40 to 50 pounds each. In calculating the financial results, cotton-seed meal was valued at $20, raw or soaked cotton seed at $6, boiled cotton seed at $8, and roasted cotton seed at $9 per ton, and shelled corn at 40 cents per bushel, no account being taken of the value of the manure or the care of the animals. The results of the trial in 1892 are summarized below:

Gains in live weight of pigs and the cost of food.

	Gain in live weight during trial.			Cost of food for lot.	Average cost of food per pound of gain.
	Large shoat.	Medium shoat.	Small shoat.		
	Pounds.	*Pounds.*	*Pounds.*		*Cents.*
Lot 1, corn and cotton-seed meal	16	19	15	$2.17	4.34
Lot 2, corn and soaked cotton seed	16	6	15	1.58	4.27
Lot 3, corn and boiled cotton seed	22	26	20	1.74	2.56
Lot 4, corn and roasted cotton seed	15	21	17	1.70	3.21
Lot 5, corn alone	59	46	26	3.29	2.51

Placing the different foods in order of value as to cost per pound of gain produced at prices given, we have the following: (1) Corn; (2) corn and boiled cotton seed; (3) corn and roasted cotton seed; (4) corn and raw cotton seed, soaked; (5) corn and and cotton-seed meal.

It will be noticed that, with exception of a medium-sized shoat in pen No. 2, which literally refused to eat until starved to it, the medium-sized shoats (five to seven months old) were able to make best use of cotton seed and cotton-seed meal. The large shoats (ten to twelve months old) and the small ones (three and one half to four months old) rank nearly equal in gain per day, but when relative weights are considered it will be seen that the balance is largely in favor of the smaller shoats. [The authors believe that] there is no profit whatever in feeding cotton seed in any form or cotton-seed meal to hogs of any age. * * * It is practically impossible to prepare cotton seed or cotton-seed meal in any manner so that hogs will eat it greedily. * * * Even at the high price taken in our estimate the tables show that corn is far ahead of cotton seed in any form or cotton-seed meal as food for hogs, and if we figure on a lower price the difference in its favor will be greatly increased.

Roasting is believed to render cotton seed less laxative in its effects. Of the different ways of preparing cotton seed for feeding to hogs, the experience of the author is in favor of boiling. The Green cotton seed roaster is described. The cost of roasting by this machine is estimated at about $3 per ton of seed.

With regard to the effects of cotton seed and cotton-seed meal on the health of the animals, it is stated that in the experiment in 1891 ten out of the twenty pigs died within from seven to ten weeks after the feeding of cotton seed or meal was commenced, and in the experiment in 1892 seven of the fifteen pigs died within from six to nine weeks.

Sickness and usually death uniformly occurred within a period of six to eight weeks from time of first feeding cotton seed or cotton-seed meal. In tests for 1892 the feeding began February 8, and the first death occurred March 23—exactly six weeks later. In tests for 1891 feeding began January 20, and first death occurred March 13—almost exactly seven weeks later. In the outbreaks noted as occurring in the college herd the trouble began each time in less than ten weeks from the time of feeding cotton-seed meal. The trouble continues for a period of about thirty days, and those animals which are not attacked within that time may safely be regarded as cotton-seed-proof. Following our tests for 1891, several of the shoats which were not attacked in the spring were kept all summer on a diet largely cotton seed or meal; but beyond a practical stoppage of growth and consequent permanent stunting of the pigs no injurious effects resulted.

It is noticed that in tests for 1892 the medium and the small-sized shoats in each of the different pens were the ones which suffered most, the large-sized shoats in all of the pens resisting its [cotton seed or meal] effect and coming through safely. * * * Two out of three were lost from each pen, except the boiled-seed pen, where only one died. [In 1891] in the cotton-seed meal pen every hog (five) died within ten days after sickness first appeared. In the roasted-seed pen four out of the five succumbed, and in the boiled-seed pen but one was taken.

It is of course needless to state that the corn-fed hogs in no case showed any signs of sickness whatever. The fact that much the lightest death rate was observed on boiled seed each year, and that the single death that did occur each year was latest as compared with all the deaths recorded, would indicate that thorough boiling has the effect of lessening danger in the use of cotton seed for hogs.

The symptoms of the affected animals are described by the authors and by M. Francis, veterinarian of the station.

Breeding statistics, F. L. RUSSELL (*Maine Sta. Report for 1891, pp. 208, 209*).—The following is a summary of statistics obtained in response to a circular of inquiry sent out by the station to farmers in the State:

Duration of period of gestation of 257 cows.

	Days.
Maximum period	304.00
Minimum period	243.00
Average when calf was a bull	281.74
Average when calf was a heifer	281.69
General average	281.72

Weights of 113 calves at birth.

	Pounds.
Maximum weight	122.00
Minimum weight	40.00
Average weight of 58 bull calves	76.80
Average weight of 55 heifer calves	70.11
General average	73.62

Relation of the time of service of 158 cows to the sex of the calves.

Eighty-two cows served during the first part of heat produced 31 bull calves and 51 heifer calves.

Seventy-six cows served during the last part of heat produced 42 bull calves and 34 heifer calves.

Live stock at Louisiana State Station, D. N. BARROW (*Louisiana Stas. Bul. No. 17, 2d ser., pp. 499, 500*).—Brief statements are made regarding the Holstein and Jersey cattle kept at the station. The number of eggs laid by thirteen different breeds of hens during one hundred days (February 6 to May 17) is stated in a table. An incubator is being used at the station with a view to encouraging the farmers of the region to raise chickens for the winter and spring market.

VETERINARY SCIENCE AND PRACTICE.

The Koch test for tuberculosis, H. P. ARMSBY and L. PEARSON (*Pennsylvania Sta. Bul. No. 21, Oct., 1892, pp. 19*).—A cow of the station herd having been found to be suffering with tuberculosis, all the other members of the herd (forty-six adults and twelve calves) were tested with tuberculin, with a view to determining whether any of them were affected with this disease. An independent physical examination of the herd was made at the same time by a veterinarian, who had no knowledge of the results of the Koch test. The temperatures of the animals before and after the injection of tuberculin are tabulated. Five

animals were put under suspicion by either the Koch or physical test, as follows:

Name of cow.	*Koch test.*	*Physical examination.*
Carmina,	Tuberculous,	Tuberculous.
Gertrude,	Tuberculous,	Not tuberculous.
Lavender,	Not tuberculous,	Tuberculous.
Cowslip,	Not tuberculous,	Probably tuberculous.
Rosella,	Not tuberculous.	Probably tuberculous.

These animals having been slaughtered, it appeared that both of those which gave a temperature reaction with the Koch test were tuberculous and that the other three were not tuberculous, but had lung lesions which deceived the veterinarian who made the physical diagnosis.

The nature and symptoms of tuberculosis in cattle and the methods employed for detecting its presence are described by Dr. Pearson, whose experience is favorable to the use of tuberculin in diagnosis. He calls especial attention to the necessity for the exercise of good judgment in the use of the new method.

> We have not yet reached the time when it will be possible to give each animal in a herd the same dose of tuberculin, measure the temperatures, and blindly declare each animal which reacts tuberculous and the others healthy.
>
> It is necessary to consider the condition, constitution, size, and age of the animals, the age of the tuberculin, the external and body temperatures at the time of injection, and other small points which are important, but which would carry us beyond the limits of this paper if discussed in detail. Much is to be learned by experience with this agent, and none of its users have so much faith in it as those who have failed with it a few times and afterwards discovered the cause of the errors.

Antiseptic treatment of wounds, E. P. NILES (*Virginia Sta. Bul. No. 18, July, 1892, pp. 71–73*).—Brief accounts of experiments with lysol, creolin, dermatol, iodol, aristol, oxide of zinc, and bichloride of mercury on cultures of *Staphylococcus pyogenes aureus*. This work was in continuation of that recorded in Bulletin No. 13 of the station (E. S. R., vol. IV, p. 74).

Lysol in 2 per cent solution prevented the growth of microörganisms. Used for washing a deep wound on a horse, it materially decreased the amount of suppuration. It was also useful in keeping flies away from the wound. Creolin in 1 per cent solution retarded the growth of the pus-producing organisms, but did not destroy them in fifteen minutes. Dermatol, iodol, aristol, and oxide of zinc were not successfully used as antiseptics. Bichloride of mercury in a solution of 1–1,000 retarded the growth of the organisms, but was not strong enough for practical purposes. "A stronger solution is injurious to the tissue and interferes with the germicidal action of the leucocytes."

Inquiry concerning stock diseases in Florida (*Florida Sta. Bul. No. 17, pp. 15, 16*).—A list of questions sent to farmers in the State regarding "big head," "salt sickness," etc.

DAIRYING.

E. W. Allen, *Editor*.

Cream-raising by dilution, H. H. Wing (*New York Cornell Sta. Bul. No. 39, July, 1892, pp. 77–85*).

Synopsis.—The average of twenty-three trials with milk set at 60° F. and of eight trials with the same milk set at 40° F. indicated that when set at 60° milk diluted one third with warm water creamed more perfectly than undiluted milk, but that when set at 40° there was no advantage from dilution. The creaming was much more perfect at 40° than at 60°. A summary of these and previous results at this station and at the Vermont Station indicates that dilution can not be regarded as a substitute for cold-setting in ice water. Setting diluted milk in the open air in winter proved inferior to setting in the creamer, where a uniform low temperature was maintained.

Reference is made to previous work on this subject reported in Bulletins Nos. 12 and 18 of the Illinois Station (E. S. R., vol. II, p. 404; III, p. 779), Newspaper Bulletin No. 3 and Annual Report for 1890 of the Vermont Station (E. S. R., vol. III, p. 476), and Bulletins Nos. 20 and 29 of the New York Cornell Station (E. S. R., vol. II, p. 284, and III, p. 230). "The results of these various experiments have not been entirely concordant, although in the main they have not been favorable to the practice of dilution." The results at the Vermont Station when the milk was set at 60° F. were favorable to dilution, and the creaming of the diluted milk was nearly as complete as that of undiluted milk set at 40°; but at the New York Cornell Station, on the contrary, diluted milk at 60° creamed less perfectly than undiluted milk set either at 60° or at 40°. It was on this point especially that the present experiments were made.

Twenty-three trials were made in which milk was set in Cooley cans in a creamer kept at about 60° F., one portion of the milk in each case being set undiluted and another diluted with one third of its weight of warm water at 135° F. Of these trials, fifteen were with the mixed milk of the university herd, six with milk from four fresh Jerseys, and two with milk from five Holsteins somewhat advanced in milk. The trials were made in February, March, and April. In every instance a full can of milk was set for twenty-four hours, the milk was skimmed to the last mark but one of the scale, and the percentage of water found in the skim milk was corrected for the amount of water added in the case of diluted milk. The percentage of fat in the skim milk was determined by means of the Babcock asbestus method. The tabulated results of these trials show that in every case but two the diluted milk creamed more perfectly than the undiluted milk, the difference being most marked in the case of the Jerseys and least so in that of the Holsteins. The average results of the trials were as follows:

Creaming of diluted and undiluted milk set at 60° F.

	Percentage of fat in skim milk.		Loss of fat per 100 pounds of milk set.	
	Diluted	Undiluted	Diluted.	Undiluted.
	Per cent	*Per cent.*	*Pounds.*	*Pounds.*
Herd milk, fifteen trials	0.76	1.05	0.62	0.85
Milk of fresh Jerseys six trials	0.60	1.13	0.50	0.91
Milk of Holsteins, two trials	0.63	0.82	0.54	0.66

To compare the results where the milk was set in ice water at 40°, eight trials were made simultaneously with the above, five being with herd milk, two with Jersey milk, and one with Holstein milk. As in the trials reported above, half of the milk was diluted with one third its weight of water at about 135°. While in five cases the diluted milk creamed slightly more perfectly than the undiluted milk, the averages were the same for both methods of treatment (0.23 per cent of fat in skim milk), but the creaming of both the diluted and the undiluted milk was much more perfect than where the milk was set at 60°.

The data are also given for nine trials made during February and March in which diluted milk was set in the open air in the dairy room. "While the temperature of the room was in most cases nearly as low as the temperature of the creamer, the percentage of fat in the skim milk was in general considerably larger than where the milk was set in water."

The average results of diluting milk at this station and at the Vermont Station are summed up as follows:

Percentage of fat in skim milk.

	Per cent.
Diluted milk set at 60° F., thirty-nine trials	0.77
Undiluted milk set at 60° F., thirty trials	1.00
Undiluted milk set at 40° F., twenty-six trials	0.29

It would seem, therefore, that while when the milk is set at 60° or thereabouts, there is considerable advantage, so far as the efficiency of creaming is concerned, in diluting it with 25 per cent of warm water. This dilution can not be regarded as a substitute for setting in ice water without dilution, and it has the further disadvantage of requiring increased tank capacity and producing a rapidly souring cream.

Berrigan separator, H. H. WING (*New York Cornell Sta. Bul. No. 39, July, 1892, pp. 85–88*).—This apparatus is described as an air-tight cylindrical chamber, in which milk diluted with 20 per cent of water is treated for about two minutes with air under pressure of about two atmospheres. It is claimed by the manufacturer that after such treatment milk will cream within twelve hours "as completely as with any of the ordinary gravity systems of setting." A number of comparative trials were made with this apparatus, the results of which are tabulated. "While better results were obtained by the Berrigan treatment than in the untreated milk set alongside [in the open air], yet the results obtained (0.59 per cent of fat in the skim milk) would not be called satisfactory creaming."

Further trials were made to see if the Berrigan treatment would have any effect on milk afterwards set in deep cans in ice water, a can of treated and another of untreated milk being set together in a Cooley creamer.

"In the two tests made practically the same results were obtained from the untreated milk and the milk that had gone through the Berrigan machine. In one case the treated milk was diluted and in the other not diluted."

Centrifugal separation, H. H. WING (*New York Cornell Sta. Bul. No. 39, July, 1892, pp. 88–90*).—Nine trials with the De Laval horizontal separator and five with the Baby separator No. 2 are reported. The results of these are compared with the average results of setting diluted and undiluted milk in Cooley cans at 40° and at 60° and that subjected to the Berrigan treatment. The average percentage of fat left in the skim milk was 0.19 by the horizontal separator, 0.09 by the Baby separator, 0.59 by the Berrigan separator, and 0.23 by cold deep setting. The horizontal separator separated on an average 360 pounds of milk per hour and the Baby No. 2, 280 pounds.

Aëration and aërators, H. H. WING (*New York Cornell Sta. Bul. No. 39, July, 1892, pp. 90–94*).

Synopsis.—Tests of the cooling capacity of two milk coolers and the keeping qualities of aërated milk. The milk treated in two machines kept from four to five hours longer than untreated milk, and that aërated by a third process kept no longer than untreated milk. The tests of keeping quality were made during April and May.

Descriptions are given of the Star milk and cream cooler, the Champion milk cooler, and the Powell aërator. Tests are reported of the cooling capacity of the first two machines.

"We think [the Star aërator] is capable of bringing the milk very near to the temperature of the water at the rate of from 250 to 300 pounds per hour. * * * [The Champion aërator] when kept filled with ice water will cool from 225 to 250 pounds per hour down to the neighborhood of 60°. * * * The differences pointed out by the above figures seem to us to very fairly indicate the relative merits of the two machines; both are very nearly alike so far as ease of keeping clean is concerned. Where running water is not at hand we should prefer the Champion; with running water, the Star."

The Powell aërator is intended to aërate without cooling. Eleven comparative tests were made with this and the Star and Champion aërators during April and May, the keeping quality of the aërated milk and milk not aërated being noted. On an average the milk aërated with the Champion and Star aërators kept four or five hours longer than that not aërated. That aërated with the Powell aërator kept no longer than that which had not been aërated.

This difference in favor of aëration is considerably less than we had expected to obtain, but there were several conditions that are likely to have made this difference less than it would be under ordinary circumstances. In the first place the

air in which the milk was set was comparatively uniform in temperature and free from contaminating odors; in the second place only a short time elapsed after milking and aëration, so there was little chance for contamination in the stable. Then again all the surroundings of the cattle were kept as neat and clean as could well be done. We believe that under the conditions that affect most dairies the good effect of aëration would be more pronounced than those we obtained.

Regarding the effect of aëration on the creaming of milk by gravity, four trials made with aërated m..k set in Cooley cans at 40° and skimmed after twenty-four hours showed the skim milk from the aërated milk to contain on an average 0.53 per cent of fat and that from the milk not aërated 0.31 per cent.

What is remarkable is that the aërated milk suffered no fall of temperature after it was placed in the creamer, and was more efficiently creamed than the diluted milk set at 60°, where the fall of temperature was 30°–35°. This seems to be in direct contradiction to the theory which supposes that the fall of temperature after the milk is set is one of the chief factors in complete creaming by the deep-setting gravity process.

Tests of dairy apparatus, H. P. ARMSBY, H. J. WATERS, and W. H. CALDWELL (*Pennsylvania Sta. Bul. No. 20, July, 1892, pp. 18, figs. 4*).

Synopsis.—Tests of the Baby separator No. 2 and the Evans and Heulings milk cooler. The separator was found to separate on an average 278 pounds of milk per hour, and to give a skim milk with not over 0.05 per cent of fat. The saving effected over cold deep setting is estimated at 4.63 pounds per 100 pounds of fat in the milk. A speed of 45 revolutions of the crank per minute gave a better separation than 42 revolutions, as recommended.

The De Laval hand separator (pp. 3–18).—The principles of the separator and the peculiarities of the De Laval machine are described and illustrated. The results are tabulated of seven separate tests of this machine, each lasting from two to three days. In these the cream was ripened and churned, and tests made of the percentage of fat in the whole milk, skim milk, and buttermilk, and that recovered in the butter. In most cases the skim milk contained only a mere trace of fat, and in no case did this exceed 0.05 per cent. For every 100 pounds of fat contained in the milk on an average 99.1 pounds of fat were recovered in the cream. The average amount of milk separated per hour was 278 pounds. In those trials in which butter was made it was found that out of every 100 pounds of butter fat in the milk from 93.22 to 98.97 pounds were recovered in the butter, the average loss being 0.89 pound in the skim milk, 0.12 pound in the buttermilk, and 2.24 pounds by handling. The saving effected by the separator over cold deep setting is estimated at 4.63 pounds for every 100 pounds of fat in the milk.

In other words, by the use of the separator we should save 4.63 per cent of our raw material. The daily yield of our herd at the time these tests were made was about 400 pounds, testing 4½ per cent fat. This means a production of 18 pounds of butter fat daily. A loss of 4.63 per cent of this would equal a loss of about 1 pound of butter per day. At an average price of 25 cents per pound this would be a loss of

$91.25 per year, which is equivalent to 6 per cent interest on an investment of a trifle over $1,500. The list price of the separator is $125. It may be noted that the above estimate agrees well with a similar estimate made by Babcock, who expresses the opinion that the use of the small separator will pay with a herd of ten good cows.

In a comparison of separating by hand power and by steam power, the latter was found to give slightly better separation, presumably, it is believed, because a somewhat uniformly higher rate of speed was maintained than by hand power. It was found advisable to run the machine at a somewhat higher rate of speed than that recommended by the manufacturers, the crank being given about 45 revolutions per minute instead of 42.

The teachings of these tests are summarized as follows:

(1) The skim milk contained in most cases less than 0.05 per cent of butter fat.

(2) Out of the total possible amount of butter, but 0.9 per cent was lost in the skim milk, and but 3.25 per cent in the skim milk, buttermilk, and mechanical losses; or in other words, 96.75 per cent of the total raw material (butter fat) was recovered in the finished butter.

(3) It is estimated that the saving by the use of this machine, as compared with the use of cold deep setting will in one year, with a herd of twenty to twenty-five cows, equal three fourths the cost of the machine.

(4) The machine has proved very satisfactory in the regular work of the station creamery.

(5) The use of hand power is to be recommended only for small dairies.

Evans and Heulings milk cooler (p. 18).—Brief mention is made of trials of the Star milk and cream cooler, but no data given.

"When there is a sufficient supply of water, milk may be cooled very rapidly and efficiently by this apparatus. We have had no difficulty in cooling the milk to within 3° of the temperature of the water used, and have kept the cooled milk in summer practically sweet for two days."

Experiments in the manufacture of cheese during May, L. L. VAN SLYKE (*New York State Sta. Bul. No. 43, n. ser., June, 1892, pp. 137*).

Synopsis.—A detailed report with summary of results of fourteen experiments in cheese-making at cheese factories and at the station. Among the points brought out are the indications with reference to loss of milk constituents in cheese-making, influence of composition of milk on yield and composition of cheese, and the reason for low yield of cheese in the month of May.

The first of a series of investigations at the station on the manufacture of cheese were reported in Bulletin No. 37 (new series) of the station (E. S. R., vol. III, p. 610). In resuming this line of work the plan was, beginning with the month of May, to carry on tests for one week in each month at cheese factories and one week at the station throughout the season. The present bulletin reports the progress for the month of May, 1892. "It is hoped that it may be found practicable to issue a bulletin on the work of each month during the season, and at the end present in a special bulletin a summary of the whole season's work."

Fourteen trials are reported, eight at the station with milk from the station herd, and six at the factory with milk supplied by patrons. Whole milk was used in all cases except two. In several of the factory trials the milk was divided into richer and poorer milk and placed in separate vats. With one exception the Cheddar process was used. The manner of testing the ripeness of the milk is described as follows:

The milk in the cheese vat is heated to 84° F.; of this, 11 ounces, fluid measure, are placed in a tin cup and 1 c.c. of rennet added and incorporated by stirring. The cup is then placed in a vat of warm milk and watched until the milk begins to thicken. The time when the rennet is added should be noted, and the time when the milk begins to coagulate. If the milk is of the proper degree of ripeness it should begin to thicken in about one minute. In case the milk thickens in much less than one minute overripeness is indicated. In case the milk requires much more than one minute to thicken it is allowed to stand until repeated tests show the proper degree of ripeness, or else 5 or 10 pounds of "starter" are added. When the milk thickens in one minute, then rennet can be added to the whole and the operation of manufacture continued. * * * It must be plain to every cheese maker that this method of ascertaining the degree of ripeness of milk, when intelligently used, is a marked advance over the former method of guessing or depending upon uncertain signs. Its use will tend to uniformity in results and enable the maker to control another step of the process.

It is suggested that more uniform results might be secured in salting by adding salt in proportion to the amount of fat taken instead of the quantity of milk taken. Since the saltness of cheese affects the rapidity with which it ripens, uniformity in salting is desirable to secure a uniform product. This method, however, was not followed in the experiments described.

The determinations of fat in the milk, whey, and cheese were all made by gravimetric methods. The data of the separate trials are tabulated and discussed at length. They include analyses of the milk, whey, and green cheese. The essential results of the trials are summarized as follows:

Loss of milk constituents in cheese-making.—The amount of fat lost in the whey increased in some cases and decreased in others when the amount of fat in the milk increased.

The average amount of fat lost in the whey in all the experiments was 0.29 pound (about 4½ ounces) for 100 pounds of milk, which was about 7.5 per cent of the fat in the milk. In the factory experiments the average loss of fat was about 9 per cent of the fat in the milk, while in the station experiments the average loss was about 7 per cent of the fat in the milk.

The amount of casein and albumen lost in the whey increased quite uniformly when the casein and albumen in the milk increased.

The average amount of casein and albumen lost in the whey in all the experiments was 0.74 pound (about 12 ounces) for 100 pounds of milk, averaging 0.64 pound in the factory and 0.81 pound in the station experiments. From 23.5 to 24 per cent of the casein and albumen in the milk was lost, the proportion of loss being quite uniform in all the experiments.

Of the 0.74 pound (or 12 ounces) of casein and albumen lost, 0.15 pound (about 2¼ ounces) consisted of casein and 0.59 pound (about 9½ ounces) of albumen. About 6 per cent of the casein and 82 per cent of the albumen in the milk was lost on an average.

In the various lots of milk used there were on an average 2.4 pounds of casein and 0.72 pound of albumen, or for every pound of albumen there were about 3.3 pounds of casein.

Influence of composition of milk on composition of cheese.—The proportion of fat in the cheese increased as a rule when the amount of fat in the milk increased, but the increase of fat in the cheese was not uniform with the increase of fat in the milk. Green cheese, made from factory milk that contained about 3 pounds of fat in 100 pounds of milk, contained about 33 pounds of fat in 100 pounds of cheese. Cheese made from whole milk to which cream had been added, and which contained 6 pounds of fat in 100 pounds of milk, contained 42 pounds of fat in 100 pounds of cheese. Cheese made from milk containing about 3.35 pounds of fat in 100 pounds of milk, contained about 35 pounds of fat in 100 pounds of cheese; when the milk contained about 4.25 pounds of fat in 100 pounds of milk the cheese contained from 36 to 36.5 pounds of fat in 100 pounds of cheese. In case of milk partially skimmed, containing 3.56 pounds of fat in 100 pounds of milk, the cheese contained nearly 32 pounds of fat in 100 pounds of cheese.

Basing a comparison of results upon the water-free cheese, instead of green cheese, we obtain results that are quite similar in their relations.

In general the fat exercised a greater influence upon the composition of the cheese than any other constituent of the milk.

In the cheese made from the normal milk, the amount of casein and albumen in 100 pounds of cheese was a fairly uniform quantity, varying in the green cheese from 22 to 24 pounds and in the water-free cheese from 36 to 38 pounds. The milk containing least fat made cheese containing a little more casein and albumen. Skimming the milk partially largely increased the amount of casein and albumen in the cheese, while adding cream to whole milk diminished the amount of casein and albumen in the cheese.

The results appear to indicate that in cheese made from normal milk, containing from 3 to 4.25 pounds of fat in 100 pounds of milk, there should be about 1.4 pounds to 1.5 pounds of fat for 1 pound of casein and albumen in the water-free cheese. Partial skimming reduced this ratio to 1.22 pounds, while addition of cream raised it to over 2 pounds.

Influence of composition of milk on yield of cheese.—Of the increased yield of cheese obtained in the various experiments, nearly one half of the increase, on an average, was due to an increase of fat in the milk from which the cheese was made.

The amount of fat retained in the cheese made from 100 pounds of milk increased when the amount of fat in the milk increased, but not with exact uniformity.

On an average the increase of casein and albumen in the milk produced a little over one fifth of the increased yield of cheese observed in the various experiments.

The amount of casein and albumen retained in the cheese made from 100 pounds of milk increased quite uniformly when the amount of casein and albumen in the milk increased.

About one third of the increased yield of cheese was due to an increased amount of water retained in the cheese.

The amount of water retained in the cheese made from 100 pounds of milk was quite variable, and increased when either the fat or casein and albumen in the milk increased.

Yield of cheese.—Of the factory milk, there were required on an average 11.4 pounds to make 1 pound of cheese. Of the station milk, 8.8 pounds sufficed to make 1 pound of cheese.

The low yield of cheese from the factory milk was mainly due to the small amount of fat, casein, and albumen contained in it, that is, to the poor quality of the milk, and in addition the loss in manufacture was a little greater. The poor quality of the milk was probably due to the fact that the cows were in the earlier stage of their period of lactation.

Influence of variation of conditions of manufacture.—In two sets of comparisons [using different amounts of rennet], only one case showed any difference in loss of fat, casein, and albumen, and this was when the amount of rennet used was much less than the usual amount. No difference of yield was shown that could be attributed to variation in the amount of rennet used. In two sets of comparisons [of cutting curd in hard and soft condition], one case of soft cutting gave a little larger loss of fat and casein. In one case the soft-cut curd gave a larger yield, owing mainly to the retention of more moisture.

Loss of cheese in weight during first month.—The loss of weight varied for the first month from 5.5 to 8.87 pounds, and averaged 6.95 pounds for each 100 pounds of green cheese.

AGRICULTURAL ENGINEERING.

Irrigation engineering, L. G. CARPENTER (*Colorado Sta. Report for 1891, pp. 45–57*).—The plan of work in 1891 was the same as in previous years, and included investigations relating to return or seepage waters, evaporation from reservoirs, and duty of water.

Return or seepage waters.

After a country has been irrigated for some time there are some changes in the régime of streams, so that these are more regular in their flow, especially in the dry season; often they may be repeatedly drained to the last drop and soon after have enough to make a respectable stream. Most of this return is from invisible sources, or in quantities too small to measure. While an increase in the volume of streams is noticed in a non-irrigated country, in many of the irrigated valleys the return is attributed to irrigation * * *

We have not observations which will absolutely prove that this increase is due solely to irrigation, but the fact familiar to all irrigating countries, that land previously dry becomes saturated and requires draining because of the seepage from ditches or irrigated lands of higher location, and other analogous facts, render it very probable that most if not all of the return observed is due to the return from the waters which have been applied in irrigation. * * * It is possible that irrigation in the upper valley of a river is beneficial to the lower valley by the return water in the season during the period of low water.

Measurements of the return waters of the Cache a la Poudre River, made at different times, are tabulated:

Comparison of measurements of return or seepage waters, Cache a la Poudre River.

[Measures in cubic feet per second.]

Date.	Return Cañon to Larimer and Weld Canal.	Return Larimer and Weld to No. 2 Canal.	Return No. 2 to Ogilvy Canal.	Total return Cañon to—	
				Ogilvy Canal.	Mouth of Poudre.
1885, Oct. 12	11.86	25.50	49.54	86.90	....
1889, Oct. 14–17	11.27	36.79	44.50	92.56	98.96
1890, Oct. 16–18	25.79	13.66	20.87	77.57	100.79
1891, Oct. 28–30	16.41	8.71	33.16	58.31	77.71
1892, Mar. 10–12	....	57.31	35.80	96.11	....

These figures do not substantiate the view that the return is increasing.

Evaporation.—Measurements on tanks placed in the ground at the station and at the Divide and Rocky Ford Substations and on floating tanks in a canal and on a lake are tabulated. These tanks were arranged as described in the Annual Report of the station for 1888, p. 164 (E. S. Bul. No. 2, part I, p. 34). The results are given in the following table:

Comparative evaporation, 1891.

Station.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	Inches	*Inches.*	*Inches*	*Inches.*	*Inches*	*Inches.*	*Inches.*	*Inches.*
Agricultural College, monthly	5 63	4.97	5.72	4 91	4.12	3.62	1.73	0.77
Agricultural College, daily	0 16	0.17	0.18	0.16	0.14	0.12	0.06	0.02
Divide..........	....	7.83	5.12	4.13	5.32	....	....	....
Rocky Ford	....	7.44	7.24	6.50	6.75	0.56	....	....

Observations for 1890 reduced by the formula $E=0.39\,(T-t)\,(1+0.02\,W)$, discussed in the report of the station for 1889 (E. S. R., vol. II, p. 394), gave the following results: Total evaporation observed, 156 days, 23.30 inches; computed, 23.74 inches.

The duty of water.—Experiments were undertaken in 1891 to determine the total amount of water used in irrigation as well as that required for each of the various crops grown in the irrigated area. The results were incomplete and unsatisfactory, and are withheld until further data have been accumulated.

Experiments in tile drainage at Louisiana State Station, D. N. BARROW (*Louisiana Stas. Bul. No. 17, 2d ser., pp. 497, 498*).—Observations in 1891 on the effects of the system of tile drainage in use at the station gave the following indications: (1) Drainage started and stopped earlier in tiles placed at a depth of 3 feet than in those at greater depths; (2) drainage was not much more rapid with tiles 20 feet apart than with tiles 40 feet apart; (3) no blight was observed on cotton on the drained land; (4) crops on the drained land suffered relatively little from drouth; (5) the drained land could be cultivated sooner after heavy rains.

STATION STATISTICS.

Fifth Annual Report of Arkansas Station (*Arkansas Sta. Report for 1892, pp. 58*).—This is for the fiscal year ending June 30, 1892, and includes brief statements regarding the work and equipment of the station, a financial report, and Bulletins Nos. 16–19 of the station, abstracts of which have been published in the Record. Arrangements have been made for the establishment of an additional substation at or near Camden, in the southern part of the State. Successful experiments with wheat, oats, grasses, and clover are reported from the substations at Newport and Pine Bluff, localities in which cotton is now the chief crop.

Fourth Annual Report of Colorado Station (*Colorado Sta. Report for 1891, pp. 130*).—This contains brief general statements regarding the work in the departments of agriculture, botany and horticulture, chemistry, meteorology and irrigation, and entomology, and at the San Luis Valley, Arkansas Valley, and Divide Substations, together with reports by the director and a visiting committee appointed by the Colorado State Horticultural Society and the State Grange. There is also a financial statement for the fiscal year ending June 30, 1891.

Reports of director and treasurer of Maine Station for 1891 (*Maine Sta. Report for 1891, pp. ii–viii*).—The report of the director contains brief general statements regarding the work of the station. The author urges the necessity of limiting the scope of the station's work to those investigations which can be thoroughly carried on. He also recommends that the State should provide means for conducting the fertilizer inspection, which is now paid for out of the funds given the station by the United States.

The report of the treasurer is for the fiscal year ending June 30, 1891.

Fourth Annual Report of New York Cornell Station (*New York Cornell Sta. Report for 1891, pp. 419, plate 1, figs. 95*).—This includes brief statements regarding the work in the several departments of the station; a detailed financial report for the fiscal year ending June 30, 1891; and Bulletins Nos. 26–37, abstracts of which have been published in the Record. The workroom of the dairy house is described and illustrated.

First Annual Report of Washington Station (*Washington Sta. Report for 1891, pp. 31*).—This contains the text of the act of the State legislature, approved March 9, 1891, for the establishment of the State Agricultural College and Experimental Station; the act of Congress of March 2, 1887, relating to the stations; and an outline plan of experiments to be conducted by the station.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Some physical properties of soils in their relations to moisture and crop distribution, M. WHITNEY (*Weather Bureau, Bul. No. 4, pp. 90, diagrams 3*).—This is a detailed discussion of soil investigations briefly described in the Annual Report of the Maryland Station for 1891 (E. S. R., vol. IV, p. 17). The additional matter includes formulas, analytical data, and detailed descriptions and tests of methods. Among the latter may be noted experiments with a method for determining soil moisture by means of electrical resistance. This method "is based on the changing electrical resistance between two plates permanently buried in the soil, with the changing moisture content." An objection to the method lies in the apparent impossibility of securing good contact between the soil and plates. Copper plates were first used, then carbon, and finally mercury contained in clay or in flat, porous cells, but in no case did the results prove satisfactory. These experiments, however, gave an indication of a movement of soil grains which has been made a subject of study.*

[For this purpose] a thin rubber ice bag with a capacity of approximately 1,000 c. c. was securely fastened to a rubber stopper bearing a 60 c. c. separating funnel for the admission of water, and a small tube, with an internal diameter of about 3 mm., which projected about 2 inches above the surface of the ground, and was then bent horizontally for about 18 inches in length, and was graduated the whole extent into eighths of an inch.

The rubber bag was about one third filled with water and buried in the soil, the soil being pressed around the bag so as to force the water up into the small tube. The tube being horizontal maintained a constant pressure whether the bag expanded or contracted, and when the water fell in the tube, as it did almost every day, water was added through the separating funnel. This arrangement insured a constant pressure in the bag, and if there was any tendency for the soil to move away the bag would expand and follow it.

Tri-daily readings of this instrument and of soil thermometers are tabulated for March, April, and May, 1892. These observations indicate that there was a movement of the soil particles away from the rubber bag and a constant enlarging of the bag. This investigation is to be continued on a larger scale.

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* See also South Carolina Report for 1889, p. 70.

Insect Life (*Division of Entomology, Insect Life, vol. v, No. 1, Sept., 1892, pp. 62, figs. 6*).—This number contains the following articles:

Rose sawflies in the United States, C. V. Riley (pp. 6–11).—A full account of the sawflies affecting the rose in the United States, viz, the bristly roseworm (*Cladius pectinicornis*), banded emphytus or curled roseworm (*Emphytus cinctus*), and American rose slug (*Monostegia rosæ*). The life history of the first-mentioned species is given in detail, together with descriptions and figures of the insect in all its stages. All these species are amenable to the usual sawfly remedy, viz, spraying with a mixture of powdered hellebore in water. A wash sufficiently strong for the destruction of the larvæ may be made by mixing 2 ounces of hellebore with 2 or 3 gallons of water.

An experiment against mosquitoes, L. O. Howard (pp. 12–14).—A paper read before the meeting of the Association of Economic Entomologists at Rochester, New York, August 16, 1892. A small pool of water measuring 60 square feet was treated with 4 ounces of kerosene, and as a result all aquatic larvæ, including those of the mosquito, were killed, and female mosquitoes were killed while attempting to deposit their eggs in the water. Ten days after treatment a careful estimate was made of the number of dead insects found floating on the surface of the water. This estimate showed a total of 7,400 insects, 370 of which were mosquitoes. At this rate a barrel of kerosene, costing $4.50, will trêat 96,000 square feet of water surface. The writer believes that by the use of kerosene, the drainage of swamp lands where practicable, the introduction of fish into ponds where they do not occur, and the careful watching of rain water barrels and tanks the mosquito plague may be greatly lessened.

Occurrence of Bucculatrix canadensisella, Chamb., on birches in Rhode Island, A. S. Packard (pp. 14–16).—An illustrated account of the destructive Tineid moth (*Bucculatrix canadensisella*) on the leaves of *Betula populifolia* in Rhode Island.

New injurious insects of a year, C. V. Riley (pp. 16–19).—A paper read before the American Pomological Society, comprising a list of about fifty of the more important insects that have been reported to the U. S. Department of Agriculture as injurious to fruit during the year 1890–'91.

Notes on the larva of Amphizoa, H. G. Hubbard (pp. 19–22).—An illustrated account of the larva of an anomalous water beetle, *Amphizoa lecontei.*

The dipterous parasite of Melanoplus devastator in California, D. W. Coquillett (pp. 22–24).—A two-winged parasite of the devastating locust, *Melanoplus devastator*, is described as a new species under the name *Sarcophaga opifera*, and a summary is furnished of published records of the Sarcophagids that have been bred from living hosts.

A new sweet-potato sawfly, C. L. Marlatt (pp. 24–27).—An illustrated account of the *Schizocerus privatus*, a new sawfly enemy of the sweet potato.

On the nomenclature and on the oviposition of the bean weevil (Bruchus obtectus, Say) (pp. 27–33).—The first part of this editorial article consists of a history of the different scientific names that have been proposed for the bean weevil, formerly known as *Bruchus obsoletus* and *B. fabæ*, but which according to the law of priority should have the name *Bruchus obtectus*, Say. Riley's former reasoning that the species is not *B. obsoletus* is confirmed by discovery of the true *obsoletus*, and Dr. Horn's conclusion to the contrary must be rejected.

The second part of the article treats of the oviposition of the weevil in the field, and shows that the eggs are thrust in masses inside the pod.

Notes on the habits of some species of Coleoptera observed in San Diego County, California, F. E. Blaisdell (pp. 33–36).—Notes on the food plants of over thirty species of Pacific coast Coleoptera and a list of seventeen species of dried medicinal plants subject to the attack of the drug pest, *Sitodrepa panicea.*

Lucilia nobilis parasitic on man, F. Meinert (pp. 36, 37).—A translation of Dr. Meinert's article in *Særtryk af Entomologiske Meddelelser* on *Lucilia nobilis*, one of the blue-bottle flies reared from larvæ infesting the ears of man.

Biologic notes on New Mexico insects, C. H. T. Townsend (pp. 37–40).—Observations on the habits of twenty species of New Mexico Coleoptera. Of the species mentioned, *Macrodactylus uniformis*, *Allorhina mutabilis*, *Diabrotica tenella*, and *Haltica foliacea* are of economic importance. The Diabrotica, which is considered a variety of the well-known twelve-spotted cucumber beetle, is reported as attacking several cultivated plants.

Further notes on the new herbarium pest, C. V. Riley (pp. 40, 41).—The writer points out the difference between the moth described as *Carphoxera ptelearia* in Insect Life, vol. IV, p. 108, and a similar insect, *Acidalia herbariata*, which has long been known in Europe as an enemy to dried plants.

The Australian enemies of the red and black scales (pp. 41–43).—The Australian ladybird, *Orcus chalybeus*, brought to this country in the hope that it would prove an efficient destroyer of the red scale of the orange, seems thus far not to have fulfilled expectations. Another Australian ladybird, *Orcus australasiæ*, may prove of use against the red scale, as it is doing well in confinement.

General notes (pp. 43–62).—Among the subjects treated are the following: A new enemy of cotton, *Luperus brunneus*; reports of the recent appearance of the horn fly in Pennsylvania, New York, Connecticut, Texas, Massachusetts, Ohio, Iowa, and Florida; tent caterpillars on hops in the State of Washington; success of the Vedalia, recently introduced from this country into Egypt; the rascal leaf crumpler in Texas; *Gortyna nitela* on cotton; sugar cane pin borer and cane disease; clover leaf weevil in Ohio; larval habits of *Thalpochares cocciphaga*; and the botfly on human beings.

Contributions from the U. S. National Herbarium (*Division of Botany, Contributions from the U. S. National Herbarium, vol. i, No. 5, Sept. 20, 1892, pp. 129–138, plates 5*).—This includes the following articles: List of plants collected by Dr. Edward Palmer in 1890 on Carmen Island, by J. N. Rose; list of plants collected by the U. S. S. *Albatross* in 1887–'91 along the western coast of America, by J. N. Rose, B. C. Eaton, A. W. Evans, and J. W. Eckfeldt; revision of the North American species of *Hoffmanseggia*, by E. M. Fischer; systematic and alphabetic index of new species of North American Phanerogams and Pteridophytes, published in 1891, compiled by Josephine A. Clark.

Of the plants collected at Carmen Island, in the Gulf of California, five are new species, *Drymaria diffusa*, *Desmanthus fruticosus*, *Passiflora palmeri*, *Houstonia* (*Ereicotis*) *fruticosa*, and *Euphorbia carmenensis*. The first three are illustrated in the plates accompanying the article.

The plants collected by the steamer *Albatross* include a few species obtained by Prof. Alexander Agassiz, in 1891, at Cocos Island, and a larger number obtained by the same collector at the Galapagos Islands, and ferns, liverworts, and lichens from southern Patagonia, and mosses from Fuegia and Patagonia. The new species described are *Oxalis* (*Hedysarioideæ*) *agassizi*, *Bryum cœlophyllum*, *Lophocoléa apiculata*, and *Schistochila quadrifida*. The last two are illustrated.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Fixation of gaseous nitrogen during vegetation, E. BRÉAL (*Ann. Agron., 18 (1892), No. 8, pp. 269–379*).—Three experiments with cresses grown in river sand are reported. In two of these unglazed flower pots holding about 6 kg. were filled with sand and arranged so as to secure thorough drainage and aëration. Cress seeds germinated on moist filter paper were weighed and transferred to the pots, and an equal weight of the same lot of seeds was taken for analysis. The pots were moistened with a nutritive solution containing all the essential elements of plant food except nitrogen. The plants developed slowly at first (during winter months), but afterwards exhibited a normal growth and produced seeds. The amount of nitrogen in the soil at the beginning and at the end of the experiment was determined, as well as that in the water used and the crop (excluding roots) obtained. The results are given in the following table:

Nitrogen fixed by cresses growing in sand.

	Duration of experiment.	Nitrogen.					
		In seed.	In water added.	In soil at beginning.	In crop produced.	In soil at end.	Fixed during experiment.
First experiment:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Pot 1	Jan. 2–June 6	0.014	0.070	0.221	0.349	0.630	0.534
Pot 2	do	0.044	0.070	0.221	0.334	0.630	0.529
Second experiment:							
Pot 1	Oct. 4–June 1	0.022	0.100	0.510	0.701	0.390	0.459
Pot 2	do	0.022	0.100	0.510	0.521	0.390	0.279

One hundred of the seeds planted in the above experiment and one hundred of those produced were examined, with the following results:

	Weight (dry).	Nitrogen in dry matter.
	Grams.	*Per cent.*
100 seeds planted	0.145	5.8
100 seeds produced	0.105	4.6

It was suggested by Dehérain that the gain of nitrogen might be due to the microbes in the soil found by Berthelot to be capable of fixing free nitrogen. To test this a pot containing 600 grams of sand was sterilized in an oven and planted with cress seed which had been treated with corrosive sublimate. The plants grew normally at the beginning, but after reaching a height of about 0.14 meter produced a few imperfect seeds and began to languish. Duplicate pots which had not been sterilized gave a much better growth.

The experiments of Ville with rape and with a mixture of cresses and lupines, and those of Frank with oats, barley, spurry, rape, lupines, and green algæ,* are briefly reviewed as pointing in the same direction as those of the author.

From the data presented the following conclusions are drawn: A soil very poor in nitrogenous matter planted with cresses (Breal) or with various phanerogamous or cryptogamous plants (Frank) is capable of bringing these plants to maturity if pots of sufficient size (2 to 10 kg.) are employed.

The plants produced contain much more nitrogen than the seed and water used.

The nitrogen used is not entirely derived from the soil, since it appears that in some cases the soil is enriched instead of impoverished by the gain by the plant, and in cases where loss does occur it is overbalanced by the gain by the plant.

In the author's experiments there was a gain of atmospheric nitrogen through the plant or the soil. This gain, however, was not sufficient to produce seeds having as high a per cent of nitrogen as those grown in normal soil.—W. H. B.

The physiological function of the root tubercles of Elæagnus angustifolius, F. NOBBE, E. SCHMID, L. HILTNER, and E. HOTTER (*Landw. Vers. Stat., 41, pp. 138–140, figs. 2*).—Among various experiments undertaken to determine the function of the root tubercles of non-leguminous plants, those with Elæagnus have given decisive results. On June 16 two flower pots, containing sterilized nitrogen-free sand, were each planted with four Elæagnus seedlings, and six days later one was inoculated from the top with an extract of Elæagnus earth. No effect was apparent during the summer. Toward fall the inoculated plant appeared greener, but no marked difference appeared until the following spring, when it developed branches and grew vigorously. An examination of the roots revealed the presence of well-developed tubercles. Comparative measurements of two representative plants from each pot showed the inoculated plant to be 530 mm. high, with numerous branches and leaves, while the uninoculated plant was 140 mm. high, without branches and in a famished condition. There appears to be no doubt that Elæagnus through its root tubercles is able to assimilate the free nitrogen of the air. These tubercles are

* Deut. landw. Presse, 1891, p. 779 (E. S. R., vol. III, pp. 418, 732).

produced by an organism entirely distinct from *Bacterium radicicola*. It has already been obtained in pure cultures, and its nature and development will be made the subject of a future report.—W. H. B.

The diffusibility of the bacteria of Leguminosæ in the soil, F. NOBBE, E. SCHMID, L. HILTNER, and E. HOTTER (*Landw. Vers. Stat.*, *41*, *pp. 137*, *138*, *fig. 1*).—Having observed that when soils were inoculated at the surface only the upper part of the root system produced tubercles, the authors undertook experiments to ascertain whether this was due to a deficiency of oxygen in the lower part of the soil or to the limited diffusive power of the bacteria. On May 16 pea plants were set out in sterilized sand and supplied only with mineral manures. Forty-one days later, after the plants had shown marked evidence of nitrogen hunger, the sand was inoculated at a depth of 200 mm. with an emulsion of pure cultivated pea tubercle bacteria at the rate of 25 c. c. per pot (each containing 5 plants). The effect of the inoculation was soon apparent. The hunger stage was passed July 20, and the plants took on a dark green color and developed rapidly. When the plants were harvested the roots were washed out and it was observed that only the deeper roots in close proximity to the point of inoculation had produced tubercles, while the upper root system was entirely free from them. Another experiment, in which the soil was inoculated at a depth of 120 mm., showed a like inability of the infection to spread far from the point of inoculation.

It appears that the distribution of tubercles on the roots is determined by the presence of active bacteria in the soil at the proper place and time.—W. H. B.

The effect of liming on the porosity of clay soils, A. N. PEARSON (*Chem. News*, *66* (*1892*), *pp. 53*, *54*, *fig. 1*).—Three samples of clay soils were brought to the same degree of dryness, and ground and sifted to the same degree of fineness. Glass tubes were then filled to the same depth (2 inches) with the soils, great care being exercised to secure a like degree of compactness. The surface was covered with a half-inch thickness of sand, exactly 2 inches of water added in a gentle stream from a specially devised siphon apparatus, and the time required for the water to disappear below the sand noted. Samples of the same soils were mixed with ¼, ½, and 2½ per cent of quicklime, respectively, made into a paste, dried, ground, and submitted to percolation in the same manner. The average results of three trials in each case were as follows:

Effect of liming on percolation.

	Time required for percolation.							
	No. 1.			No. 2.			No. 3.	
	days	*hrs.*	*min.*	*days*	*hrs.*	*min.*	*days*	*hrs.*
Without lime	6	4	17	12	11	28	26	19
With ¼ per cent lime		12	42	10	2¾		7	23¼
With ½ per cent lime		9	56½	5	6½		2	12½
With 2½ per cent lime		2	55		8	20		7

It will be noted that in each case the addition of lime caused a marked falling off in the time required for percolation. The facts here brought out are peculiarly applicable in the management of sewage farms in clay districts. Applications of lime in such cases "would reduce the area required, render underground delivery possible when otherwise impossible, and probably assist materially in the purification of the sewage."—W. H. B.

The solubility of the phosphoric acid in bone meal, H. OTTO (*Chem. Ztg., 1892, p. 1128*).—The apparent contradiction between the results of experiments by Wagner, which showed that Thomas slag was more readily available and gave larger returns than bone meal, and those of Marek and Holdefleiss, which indicated that bone meal "should be classed as one of the surest and most effective of fertilizers," the author is able to explain only on the supposition that Wagner experimented with an inferior quality of bone meal.

Bone meal prepared from bones extracted with benzine always contains from 4¾ to 5 per cent of nitrogen, 21 to 23 per cent of phosphoric acid, and generally less than 2 per cent of fat. Bone meal containing less than 4 per cent of nitrogen and 20 per cent of phosphoric acid is not pure untreated meal. The phosphoric acid of Thomas slag (ground sufficiently fine) has been found to be highly soluble in citrate solution. That the phosphoric acid of bone meal (nearly fat free) is also very soluble, the following results show:

	Mesh of sieve.	Phosphoric acid.	Nitrogen.	Phosphoric acid.	
				Soluble.	Per cent of whole.
	Mm.	*Per cent.*	*Per cent.*	*Per cent.*	
(1) Bone meal from ground extracted bones	1.5	22.2	4.75	8.05	38.28
Do	1.0	22.2	4.75	9.15	41.20
(2) Coarse bone (*Stampfmehl*)	1.0	19.0	5.10	7.40	38.94

It is believed that the decomposition of the gelatin of the bone in the soil increases the availability of the phosphoric acid they contain.—W. H. B.

A review of the chemistry of tobacco, R. KISSLING (*Chem. Ztg., 1892, pp. 153–155*).—The present paper is in continuation of a résumé published by the author in 1884* and treats of the contributions subsequent to that time. Regarding the purely chemical side of the subject little has appeared within the last decade. The tannic acid found in tobacco and for a time supposed to be peculiar to tobacco, was recognized by T. J. Savery† to be the same as that occurring in coffee. In connection with the chemistry of drying and fermenting, the investigations of Müller-Thurgau‡ on the relation of starch and sugar in tobacco

* Chem. Ztg., 1884, pp. 68, 103, 119, 172, 190.
† Chem. News, 49 (1884), p. 147.
‡ Landw. Jahrb., 14 (1885), p. 465.

leaves are of special interest. These showed that the tobacco leaf, like other leaves, is relatively rich in starch at night and poor in the morning, although the differences found were relatively small, for at a medium temperature only about one fifth of the starch present disappeared. Fully ripe leaves are rich in starch both morning and evening, and the consumption of sugar is very small except in the neighborhood of growing parts. The dry substance of fresh ripe tobacco leaves consists of from one third to nearly one half starch. It also contains considerable amounts of sugar. Fermented tobacco, on the contrary, is usually poor in starch and entirely free from sugar. The presence of starch in fermented leaves depends upon the ripeness and the manner of drying. Leaves which are dried very rapidly always contain starch and in some cases considerable amounts. The presence of starch in the leaves may also be due to injury to the epidermis of the green leaves by breaking, scratching, or pinching in cutting them. Evaporation takes place rapidly at the injured places and the cells dry out before the starch is all changed into sugar. During drying the main bulk of the starch disappears in the first few days, and finally the last trace if the evaporation is not allowed to go on too rapidly. Dried tobacco always contains sugar, that dried rapidly containing less than that dried slowly, as follows from the above. During the process of fermentation the sugar entirely disappears, but starch, if present, seems to be attacked only with difficulty. Müller-Thurgau found the following proportions of starch and sugar in tobacco leaves:

Per cent of starch and sugar in dry matter.

	Starch.	Sugar.
Unripe leaves	31.4	1.2
Nearly ripe leaves	38.4	1.0
Fully ripe leaves	42.6	0.8

Fesca* showed that the contents of amide compounds in unfermented leaves is relatively small, and that one of the most important functions of the fermentation is the changing of the albuminoids to amides.

The methods for determination of nicotine proposed by the author, by Popovici†, and by Fesca in the paper cited above, are referred to. As to the constitution of nicotine, it is still regarded as a matter of question, although recent investigations are strongly opposed to the theory that it is a dipyridyl derivative.

Concerning the culture of tobacco the number of investigations appearing is relatively large. The investigations of van Bemmelen‡ on tobacco growing in Sumatra and Java are especially interesting. The tobacco of these countries has been valued for cigar wrappers on

*Landw. Jahrb., 17 (1888), p. 346.
†Zeitsch. physiol. Chem., 13 (1889), p. 445.
‡Landw. Vers. Stat., 38 (1890), p. 394.

account of the thinness and toughness of the leaves. For several years, however, the tobacco produced has been of inferior quality in this respect, and van Bemmelen sought the reason and remedy for this. He came to the conclusion that the trouble lay first of all in the physical condition of the soil. The newly cleared land of Deli in Sumatra is highly adapted to the growth of tobacco, but after a few years of culture the properties of the soil which make it so are found to disappear. Van Bemmelen recommended a rotation between tobacco culture and forest culture, a practice only applicable to tropical countries. After two years of tobacco culture the land was to be left to itself for six or eight years, which is sufficient to reforest it.

The investigations of A. Mayer*, Nessler†, and M. Barth‡ on manuring tobacco are referred to. The conclusions from these are in general that fertilizers containing chlorine should be avoided, and that heavy applications of potash manures and materials forming humus in the soil should be made.

In connection with fertilizer experiments, Nessler, van Bemmelen, A. Mayer, Fesca, and M. Barth have made experiments on the glowing qualities of tobacco. The views of these investigators agree in general, although in some minor points they do not. Their investigations seem to have shown beyond much doubt that potash is favorable to the glowing, that chlorine is unfavorable, and that the effect of potash is most plainly seen when a part of the potash is in combination with organic acids, that is, when the tobacco ash consists largely of bases with relatively low content of sulphates, chlorides, and (probably) phosphates.

The opinions with reference to the effect of organic substances, especially albuminoids and resins, are at variance.

The subject of the fermentation of tobacco has received valuable contributions from Suchsland.§ He found that the fermentation was caused by bacteria and that the number peculiar to the fermentation of any single variety of tobacco was small, usually only two or three. The indications are that the quality of tobacco may be much improved by controlling the fermentation—inoculating more common tobacco with pure cultures peculiar to the choicer sorts. Suchsland has established in Halle a laboratory for tobacco ferments, in which the characteristic bacteria of the best Havana, Brazilian, Greek, and Turkish tobacco are to be cultivated, and from which these different ferments may be distributed. Hanausek states that in Cuba a crude method for improving tobacco is used, which rests upon the same principle as that discovered by Suchsland.—E. W. A.

The California vine disease (Plasmodiophora californica), P.

* Landw. Vers. Stat., 38 (1881), p. 453 (E. S. R., vol. II, p. 457).
† Summary in E. S. R., vol. IV, pp. 302–308.
‡ Landw. Vers. Stat., 39 (1891), p. 81.
§ Ber. deut. bot. Ges., 9 (1891), p. 42; E. S. R., vol. III, p. 354.

VIALA and C. SAUVAGEAU (*Compt. rend., 115 (1892), No. 1, pp. 67–69*).—A study of this disease in connection with that known as Brunissure has led to the conclusion that both are due to a species of Myxomycetes of the genus *Plasmodiophora.* Although the material available for study was somewhat limited the authors believe the California disease to be distinct from the Brunissure and due to a new species, for which they propose the name *Plasmodiophora californica.*—W. H. B.

A simple method for recognizing adulterations of peanut cake, L. HILTNER (*Landw. Vers. Stat., 40, pp. 351–355*).—The method given for recognizing poppy seed in peanut meal depends upon the fact that peanut meal contains starch, while poppy seed is free from starch. The suspected sample (0.2 gram) is well saturated with any iodine solution except potassium iodide solution, and water is added after a few minutes, with a few drops of alcohol to clear the solution. The result is now perceptible, but is seen more distinctly if the solution is removed by means of a filter pump and the material allowed to dry down. The air-dry material can be spread out on dark glazed paper and the poppy seed separated out with the aid of a low-power lens and weighed, showing the approximate percentage of adulteration. Potassium iodide is said to cause the particles to adhere to each other and to the plate, making the separation very difficult. If the seed of the white poppy is present it is colored brown, but can readily be distinguished from the peanut meal by its color and characteristic structure. Where the material contains much fine dust or powder separation may be aided by first screening the sample dried down with iodine through a 0.25mm sieve. Tests are reported which indicate the method to be fairly accurate. The method is believed to be applicable to the recognition of nearly all foreign materials occurring in peanut residues, since the oil-bearing seeds and other materials used as adulterants are in general free from starch.—E. W. A.

On pasteurization of milk and cream, and the use of pure cultures for souring the cream in the case of abnormal milk, H. P. LUNDE (*22 Beretning fra den kgl. Veterin. og Landbohöjsk. Lab. landökonom. Forsög. Kjöbenhavn, 1891, pp. 67–117; abs. in Centralbl. agr. Chem., 21, pp. 554–563*).—*Experiments with an abnormal milk.*—In 1888 the milk produced on a farm in Duelund, Jutland, which had produced butter commanding the highest price, became infected in such a manner that the butter manufactured from it could not be marketed. It was found that the bacteria which caused this abnormal condition of the milk could be killed by heating, and this fact was taken advantage of in practice.

Trials were first made in which the cream was pasteurized by heating at 65° to 70° C. and at 85° C., cooling rapidly, and churning the cream sweet. For purposes of comparison butter was also made from sweet and sour cream not pasteurized. The samples of butter were submitted to a jury composed of butter merchants for testing. In their opinion

the sweet cream butter was superior to that made from sour cream, but neither was equal in quality to that made from pasteurized cream. The butter from cream pasteurized at 85° C. had a "cooked" taste, which was not the case with that from cream pasteurized at 65° to 70°.

Tests of the effect of length of time of pasteurizing on the quality of the butter indicated that this factor was of no particular influence.

Another series of trials was made which showed the good effects of pasteurization on the keeping qualities of the butter. As to the effect of the material used for souring the pasteurized cream on the general and keeping qualities of the butter, experiments were made in which the cream was soured with buttermilk from a neighboring farm, with buttermilk from one of the best creameries in Denmark and with pure cultures supplied by Storch. The best butter, in the opinion of the judges, was secured where buttermilk from the creamery was used, and the next best with pure cultures; the keeping quality of the butter was in the same order.

As a result of these trials, then, it was demonstrated that first quality butter could be produced from milk which otherwise yielded butter unfit for use, by pasteurizing the cream and then souring it with buttermilk from a good creamery.

Experiments in pasteurization in 1889 and 1890.—The effect of pasteurization of cream in the case of normal milk was tested with cream from five of the best creameries in Denmark. As before, the butter made from pasteurized cream and that not pasteurized was compared. With a single exception pasteurization improved the quality of the butter, although that made from unpasteurized cream was classed as butter of excellent quality.

In the above experiments the cream was pasteurized by suspending a pail containing the cream in boiling water. For the use of creameries it was believed to be more convenient to pasteurize the whole milk rather than the cream in an apparatus made for that purpose. Accordingly trials were made in which the milk was conducted from the milk vat by two pipes, passing in one case directly to the separator and in the other through a Fjord pasteurizing apparatus, where it was heated to 70° C., and then to the separator. The cream from both separators was cooled rapidly, soured by similar means, and churned. Experiments of this nature were made with stall-fed cows and cows at pasture on three farms. There was scarcely any improvement of the butter from pasteurizing the milk of the stall-fed cows, and only a slight improvement in the case of cows at pasture. A series of trials was then made on a single farm, in which butter was made from separate samples of pasteurized and unpasteurized whole milk and pasteurized cream. The results showed that while in five out of seven cases there was little difference in the quality of the fresh butter from pasteurized milk as compared with that from pasteurized cream, the keeping quality of the butter from pasteurized milk was best. The buttermilk from pasteur-

ized milk and cream contained slightly more fat than that from unpasteurized portions. Analyses of the butter made in the separate trials showed that in general the butter from pasteurized cream contained 0.61 per cent less water than that from unpasteurized cream, and that the butter from pasteurized whole milk contained about 1.14 per cent less water than that from unpasteurized milk.

Special experiments were made to determine whether pasteurization resulted in an absolute loss of butter fat. There were six of these tests in which the pasteurized milk was skimmed by means of a centrifugal separator, and analyses made of the separator skim milk, of the whole milk, and of the butter. The results showed that under corresponding conditions the pasteurized milk was more thoroughly creamed than unpasteurized milk, although no difficulty was found in thoroughly creaming the latter by increasing the speed of the separator or allowing the milk to run in more slowly. The percentages of butter fat in 100 kg. of whole milk and that recovered in the butter from the same by different methods of treatment are given, as follows:

	Butter fat in 100 kg. of milk.	Butter in 100 kg. of milk.
	Kg.	*Kg.*
Cream not pasteurized	2.84	3.57
Cream pasteurized	2.83	3.49
Whole milk pasteurized	2.86	3.48

There was therefore a loss from pasteurization amounting to about 2 per cent. These results were verified in experiments carried on at other places.—E. W. A.

Old and recent Danish experiments on the keeping qualities of milk and its improvement by pasteurization, N. J. FJORD and H. P. LUNDE (*Beretning fra den kgl. Veterin. og Landbohöjsk. Lab. landökonom. Forsög. Kjöbenhavn, 1884 and 1891; abs. in Centralbl. agr. Chem., 21, pp. 621–628*).—Experiments are first reported which were made by Fjord in 1884, and which indicated in brief that there was practically no difference in the keeping properties of pasteurized whole milk and the separator skim milk from the same; that there was little or no advantage from heating milk to 50° C., although the heating be long continued, while heating to from 60° to 70° C. prolonged its keeping very materially; that there was no advantage from heating above 80° and little difference between 65°, 70°, and 80° in this respect; and that the taste of cooked milk was much stronger when the milk was cooled gradually than when cooled rapidly.

Not satisfied with the accuracy of the conclusion as to the keeping properties of separator skim milk from pasteurized milk, Lunde determined to test the effect of more and less rapid cooling of the skim milk on the length of time it remained sweet. In five series of experiments

by him the average length of time during which the samples receiving different treatment remained sweet was as follows:

Unpasteurized whole milk and separator skim milk from the same and from pasteurized whole milk when the skim milk was not cooled, five to seven hours.

Pasteurized whole milk and skim milk not cooled, fifteen to sixteen hours.

Pasteurized whole milk and skim milk cooled at once, thirty-three to thirty-five hours.

In other words, pasteurization alone only slightly improved the keeping quality of milk when it was not followed by rapid cooling. The later experiments were made in summer, while those in 1884 were made in winter, which is believed to account for some points of disagreement between the two series of experiments.

The experiments of 1884 on the effects of pasteurizing milk at different temperatures on its keeping quality were repeated and the results confirmed.

The importance of cooling to a low temperature after pasteurizing was verified by another series of experiments, in which skim milk pasteurized at 70° C. was cooled to temperatures ranging from 10° to 65° C., the differently treated samples being kept in a room together at a uniform temperature. The time during which the milk remained sweet was as follows:

	Hours.
Cooled to 10° C	35.8
Cooled to 15° C	34.3
Cooled to 20° C	32.3
Cooled to 25° C	26.4
Cooled to 30° C	17.7
Cooled to 35° C	11.5
Cooled to 40° C	7.5
Cooled to 45° C	4.8
Cooled to 50° C	3.8
Cooled to 55° C	4.2
Cooled to 60° C	6.3
Cooled to 65° C	7.4
Cooled to 70° C	8.7

The importance of rapid cooling was also brought out in another series of experiments.

The conclusions from Lunde's experiments are summarized as follows:

(1) The keeping quality of separator skim milk is only slightly improved by pasteurization, unless followed by rapid cooling.

(2) The keeping quality of pasteurized milk suffers especially if allowed to remain long at a temperature between 30° and 50° C.

(3) Pasteurization at 70° to 75° followed by rapid cooling to 25° or lower greatly increases the keeping quality.—E. W. A.

Investigations on carbohydrates, B. TOLLENS and C. SCHULZE (*Landw. Vers. Stat., 40, pp. 367–389*).—The authors describe the preparation of xylose from dried brewers' grains, luffa (macerated fruit of *Luffa cylindrica*), quince slime, and wheat straw by direct hydrolysis of these materials with 2 or 4 per cent sulphuric acid. The product obtained from brewers' grains, both by extraction and inversion of the gum and by direct hydrolysis of the original material, consisted principally of xylose, with a small admixture of arabinose, the quantity of the latter being approximately the same by both methods of preparation.

Cupric ammonia was found to dissolve a mixture of cellulose and pentan (wood gum) from extracted brewers' grains, but did not dissolve all of this gum. Neither treatment with sodium hydrate solution nor with sulphuric acid served to dissolve all of the pentosans, but alternate treatment with these reagents and with cupric ammonia dissolved the whole amount of lignified fiber. It is suggested that the conclusion from this may be that cellulose and wood gum are not a single mixture but are intimately combined, perhaps as chemical compounds, in the lignified cell, and that lignin is present as a third constituent; or it may be that the cellulose itself contains pentose groups, being made up of a number of groups of $C_6H_{10}O_5$ and $C_5H_8O_4$, chemically united. Instead of one cellulose then, there might be many different forms of cellulose containing the separate groups $C_6H_{10}O_5$, $C_5H_8O_4$, and possibly others, and which could be resolved into their components, yielding besides dextrose, mannose, xylose, arabinose, etc. On the other hand it may also be conceived that there is one cellulose $(C_6H_{10}O_5)_n$ derived from dextrose, another from mannose, others $(C_5H_8O_4)_n$, derived from xylose, arabinose, etc., all possessing similar qualities with reference to their behavior toward strong potash solution and toward hydrolysis. Various mixtures of these different celluloses possessing similar qualities might then occur. The interesting results obtained by E. Schulze,* according to which "celluloses" of different kinds may be made to yield besides dextrose, mannose, and pentoses, may be explained on the basis of either of these hypotheses.

Luffa was found to give a very pure preparation of xylose by direct hydrolysis, although the yield was small (hardly 1 per cent). To observe the action of sulphuric acid on xylose and arabinose, pure preparations of these materials were digested together in a water bath, with sulphuric acid ranging from 4 to 10 per cent for thirty-two hours. It was found that both sugars resisted the action of the acids well, only 15.7 per cent of arabinose and 20.7 per cent of xylose being decomposed to humin substances. The pure preparations of these pentoses are therefore not especially susceptible to the acid, but it is believed that the gums from which they are prepared suffer a greater decomposition

* Zeitsch. physiol. Chem., 16, pp. 422–436.

in inversion, as is indicated by the yield of sugar and the impurities in the sirup.

A 10 per cent solution of xylose gave a specific rotation of 18.794° in a large Landolt-Laurent apparatus. The rotation of solutions of xylose was found to be somewhat affected by temperature, a solution which rotated 18.909° at 20° C. rotating 19.628° at 30° C.

It was found that the multi-rotation (greater or less rotation) which certain sugars show in aqueous solutions was entirely overcome by dissolving the sugar in water containing 0.1 per cent of ammonia. All the sugars tested in this manner (dextrose, levulose, galactose, lactose, rhamnose, arabinose, and xylose) gave the correct reading at once without waiting for the multi-rotation to pass. This matter is of considerable importance in laboratory practice both from the saving of time which may result and the error which might result from the presence of traces of ammonia when the multi-rotation was to be observed. A vacuum evaporating apparatus for laboratory use is described.—E. W. A.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

Notes on W. F. K. Stock's nitrogen process, W. P. SKERTCHLY.—*Analyst, Nov., 1892, pp. 209–215.*

Contributions to the determination of nitrogen by the Kjeldahl method (*Beiträge zur Stickstoffbestimmung nach Kjeldahl*), C. ARNOLD and K. WEDEMEYER.—*Zeitsch. analyt. Chem., 31, Heft 5, pp. 525–533.*

Determination of the nitrogen in urine by the Schneider-Seegen and by the Kjeldahl methods (*Zur Bestimmung des Harnstickstoffs nach Schneider-Seegen und nach Kjeldahl*), C. ARNOLD and K. WEDEMEYER.—*Arch. ges. Physiol., 52, pp. 590, 591.*

The separation of pyro-and meta-phosphoric acid (*Ueber die Trennung und Bestimmung der Pyro- und- Metaphosphorsäure*), G. v. KNORRE.—*Zeitsch. angew. Chem., 1892, Heft 21, pp. 639–641.*

On the determination of phosphoric acid (*Phosphorsäurebestimmung*), A. JOLLES.—*Oesterr.-ungar. Zeitsch. Zuckerind. u. Landw., 1892, pp. 683, 684; abs. in Chem. Centralbl., 1892, II, No. 14, p. 630.*

On the determination of phosphoric acid (*Zur Phosphorsäurebestimmung*), N. v. LORENZ.—*Oesterr.-ungar. Zeitsch. Zuckerind. u. Landw., 1892, pp. 664–666; abs. in Chem. Centralbl., 1892, II, No. 14, pp. 629, 630.*

Determination of phosphoric acid according to Spica (*Zur Phosphorsäurebestimmung nach Spica*), C. ARNOLD and K. WEDEMEYER.—*Zeitsch. angew. Chem., 1892, Heft 20, pp. 603, 604.*

Reliability of the estimation of phosphoric acid as magnesium pyrophosphate, especially in the molybdic method (*Ueber die Zuverlässigkeit der Phosphorsäurebestimmung als Magnesiumpyrophosphat, insbesondere nach der Molybdänmethode*), H. NEUBAUER.—*Zeithsch. anorgan. Chem., 2, pp. 45–50; abs. in Chem. Centralbl., 1892, II, No. 14, p. 629.*

Determination of phosphoric acid in Thomas slag (*Ueber die Phosphorsäurebestimmung in Thomasschlacken*), A. F. JOLLES.—*Zeitsch. analyt. Chem., 31, Heft 5, pp. 516–519.*

Contribution to the chemistry of Thomas slag (*Beitrag zur Chemie der Thomasschlacke*), M. A. VON REIS.—*Zeitsch. angew. Chem., 1892, Heft 8, pp. 229–231.*

A method for determining the lime in Thomas slag (*Methode zur Kalkbestimmung in Thomasphosphaten*), A. F. HOLLEMAN.—*Chem. Ztg., 1892, pp. 1471, 1472.*

On the estimation of the value of Thomas slag (*Zur Werthbestimmung der Thomasschlacken*), O. FOERSTER.—*Chem. Ztg., 1892, pp. 1596, 1597.*

Determination of hardness of drinking water (*Zur Härtebestimmung des Trinkwassers*), A. PARTHEIL.—*Apotheker Ztg., 7, p. 435; abs. in Chem. Centralbl., 1892, II, No. 14, p. 626.*

Fluorine content of bones and teeth; preliminary paper (*Zur Frage nach dem Fluorgehalt der Knochen und Zähne*), S. GABRIEL.—*Zeitsch. analyt. Chem., 31, Heft 5, pp. 522–525.*

On the occurrence of saponin in corn cockle seed (*Ueber den Sitz der Saponinsubstanz in dem Kornradensamen*), T. F. HANAUSEK.—*Chem. Ztg., 1892, p. 1643.*

Volumetric determination of alkaloids, L. BARTHE.—*Compt. rend., 115 (1892), p. 512.*

On the determination of pentoses and pentosans in plants (*Ueber die Bestimmung von Pentosanen und Pentosen in Vegetabilien durch Destillation mit Salzsäure und gewichtsanalytische Bestimmung des entstandenen Furfurols*), E. R. FLINT and B. TOLLENS.—*Ber. deut. chem. Ges., 25, Heft 15, pp. 2912–2917.*

Sucrose, dextrose, and levulose; their quantitative determination when occurring together, F. G. WIECHMANN.—*School of Mines Quarterly, 13, No. 3; abs. in Chem. News, 66 (1891), pp. 237–239 and 249–251.*

Determination of water in crude sugars (*Die Wasserbestimmung in Rohzuckern*), A. STIFT and J. KRUIS.—*Oesterr.-ungar. Zeitsch. Zuckerind. u. Landw., 1892, pp. 673–678; abs. in Chem. Centralbl., 1892, II, No. 14, p. 631.*

Determination of ash in crude sugars (*Die Aschenbestimmung in Rohzuckern*), S. NEUMANN and A. STIFT.—*Oesterr.-ungar. Zeitsch. Zuckerind. u. Landw., 1892, pp. 679, 680.*

An improved extraction apparatus for sugar beet analysis (*Verbesserter Extractionsapparat für Rübenuntersuchung*), M. MÜLLER.—*Zeitsch. angew. Chem., 1892, Heft 8, pp. 232, 233.*

A pipette and a burette for volumetric determinations in factories, G. A. LE ROY.—*Monit. scientif., 1892, ser. 4, p. 719.*

Recent investigations on the fixation of atmospheric nitrogen by microbes (*Nouvelles recherches sur la fixation de l'azote atmosphérique par les microbes*), BERTHELOT.—*Compt. rend., 115 (1892), No. 17, pp. 569–574.*

Discussions of Berthelot's investigations on the fixation of nitrogen, T. SCHLÖSING, SR., and BERTHELOT.—*Compt. rend., 115 (1892), No. 18, pp. 636–638.*

The fixation of free nitrogen by plants (*Sur la fixation de l'azote libre par les plantes*), T. SCHLÖSING, JR., and E. LAURENT.—*Compt. rend., 115 (1892), No. 18, pp. 659–661; No. 19, pp. 732–738.*

Root tubercles of Leguminosæ with respect to gas exchange (*Die auf den Gasaustausch bezüglichen Einrichtungen und Thätigkeiten der Wurzelknöllchen der Leguminosen*), B. FRANK.—*Ber. deut. bot. Ges., 10, pp. 271–280; abs. in Chem. Centralbl., 1892, II, No. 14, pp. 621–623.*

Silica in plants (*Sur la silice dans végétaux*), BERTHELOT and G. ANDRÉ.—*Ann. Chim. et Phys., 27 (1892), ser. 6, Oct., pp. 145–164.*

The mechanism of the dissolution of starch in the plant (*Sur le mécanisme de la dissolution de l'amidon dans la plante*), A. PRUNET.—*Compt. rend., 115 (1892), No. 19, pp. 751–754.*

Determination of clay and sand in soils (*Ueber die Bestimmung von Thon und Sand im Boden*), F. TSCHAPLOWITZ.—*Zeitsch. analyt. Chem., 31, Heft 5, pp. 487–501.*

On the absorptive capacity of soils, and the fixation of phosphates and ammonia salts by humic acid (*Sur le pouvoir absorbant de la terre et sur la fixation des sels ammoniacaux et des phosphates par l'acide humique*), BERTHELOT and G. ANDRÉ.—*Ann Chim. et Phys., 27 (1892), ser. 6, Oct., pp. 196–202.*

On the reversion of soluble phosphate of lime in the soil (*Beitrag zur Frage über das Zurückgehen des wasserlöslichen phosphorsäuren Kalkes im Boden*), M. STAHL-SCHRÖDER.—*Jour. Landw., 40, Heft 3, pp. 213–222.*

Effect of urine on the formation and dispersion of ammonia during the decay of solid excreta of animals (*Einfluss des Harns auf die Bildung und Abgabe von Ammoniak während der Fermentation fester thierischer Ausleerungen*), ST. JENTYS.—*Anzeig. Akad. Wissensch. in Krakau, 1892, p. 310; abs. in Chem. Ztg., 1892, Repert., p. 298.*

Influence of the diffusion of fertilizers in the soil on their utilization (*Influence de la répartition des engrais dans le sol sur leur utilisation*), T. SCHLÖSING.—*Compt. rend., 115 (1892), No. 19, pp. 698–703.*

The manufacture of superphosphate manures from phosphates rich in iron (*Ueber Herstellung superphosphathaltiger Düngemittel aus eisenreichen Phosphaten*), O. JAEHNE.—*Zeitsch. angew. Chem., 1892, Heft 8, pp. 231, 232.*

The history of maize (*Zur Geschichte des Mais*), C. HARTWICH.—*Chem. Ztg., 1892, pp. 1470, 1471.*

The introduction and spread of the maize plant in Europe (*Ueber die Einführung und Verbreitung der Maispflanze in Europa*), F. A. FLÜCKIGER.—*Chem. Ztg., 1892, p. 1559.*

The principal starches used as food, W. GRIFFITHS.—Baily & Son, Cirencester, price 5s.

A new rapid and simple method for determining starch in potatoes and commercial starch preparations (*Eine neue Methode zur schnellen und einfachen Bestimmung des Stärkemehls in den Kartoffeln und in der Handelsstärke*), A. BAUDRY.—*Dingler's Polytech. Jour., 285, pp. 238, 239; abs. in Chem. Centralbl., 1892, II, No. 14, p. 639.*

On protein meal (*Ueber Proteinmehle*), H. SPINDLER.—*Zeitsch. angew. Chem., 1892, Heft 20, pp. 607, 608.*

Method of distinguishing between rye flour and wheat flour (*Zur Unterscheidung von Weizen- und Roggenmehl*), T. WAAGE.—*Apotheker Ztg., 7, p. 430; abs. in Chem. Centralbl., 1892, II, No. 14, p. 640.*

Experiments on bread and biscuit (*Expériences sur le pain et le biscuit*), BALLAND.—*Compt. rend., 115 (1892), No. 18, pp. 665–667.*

Determination of fat in bread (*Ueber Fettbestimmung im Brot*), M. WEIBULL.—*Zeitsch. angew. Chem., 1892, pp. 850, 851; abs. in Chem. Centralbl., 1892, II, No. 14, p. 836.*

Analysis of lard (*Zur Analyse des Schweineschmalzes*), C. AMTHOR and J. ZINK.—*Zeitsch. analyt. Chem., 1892, Heft 5, pp. 534–537.*

Analysis of the nitrogenous constituents in commercial peptones (*Zur Analyse der in Handelspeptonen vorhandenen stickstoffhaltigen Bestandtheile*), A. STUTZER.—*Zeitsch. analyt. Chem., 1892, Heft 5, pp. 501–515.*

On the influence of alumed baking powders on peptic digestion, with remarks on a recent prosecution, O. HEHNER.—*Analyst, Nov., 1892, pp. 201–209.*

Analyses of German natural wines (*Analysen deutscher Naturweine*), P. KULISCH.—*Zeitsch. angew. Chem., 1892, Heft 8, pp. 238–241.*

Determination of glycerin in wine (*Ueber Bestimmung von Glycerin in Wein*), G. BAUMERT.—*Arch. Pharm., 230, pp. 324–331.*

Progress in the chemistry of wines and foods (*Fortschritte auf dem Gebiete der Chemie des Weines der Nahrungsmittel*), E. LIST.—*Chem. Ztg., 1892, pp. 1450–1454.*

Progress in the investigation of spices and their adulterations (*Fortschritte in der Untersuchung der Gewürze und deren Fälschungen*), T. F. HANAUSEK.—*Chem. Ztg., 1892, pp. 1494–1498.*

Feeding experiments with sunflower-seed cake for cows (*Fütterungsversuche mit Sonnenblumenkuchen bei Milchkühen*), KLEIN.—*Milch Ztg., 1892, pp, 673–677.*

Effect of temporarily withholding or increasing the protein of a ration on the nitrogen exchange in Herbivora (*Versuche über die Wirkung einer plötzlichen einmaligen Entziehung bezw. Vermehrung des Futtereiweisses auf den Stickstoffumsatz des Pflanzenfressers*), S. GABRIEL.—*Jour. Landw., 40, Heft 3, pp. 293–308.*

Determination of the acidity of milk (*Die Bestimmung des Säuergehaltes der Milch*), SOXHLET and H. C. PLANT.—*Abs. in Zeitsch. analyt. Chem., 1892, Heft 5, pp. 581, 582.*

On the determination of lactic acid in milk (*Zur Milchsäurebestimmung*), W. THÖRNER.—*Chem. Ztg., 1892, pp. 1469, 1470, and 1519, 1520.*

Determination of volatile fatty acids of butter fat (*Ueber die Bestimmung der flüchtigen Fettsäuren des Butterfettes*), A. PARTHEIL.—*Apotheker Ztg., 7, p. 435; abs. in Chem. Centralbl., 1892, II, No. 14, pp. 635, 636.*

Volatile fatty acids of butter; note on a recent paper by William Johnstone, H. D. RICHMOND.—*Chem. News, 66 (1891), p. 235.*

On the melting point and chemical composition of butter made on various rations (*Ueber den Schmelzpunkt und die chemische Zusammensetzung der Butter bei verschiedener Ernährungsweise der Milchkühe*).—*Milch Ztg., 1892, pp. 725–727.*

Amyloid, a new constituent of milk and dairy products (*Amyloid, ein neuer Bestandtheil von Milch und Molkerei-producten*), F. J. HERZ.—*Chem. Ztg., 1892, pp. 1594, 1595.*

Studies on sheep's milk (*Untersuchungen über die Schafmilch*), C. BESANA.—*Chem. Ztg., 1892, pp. 1519, 1561, and 1598.*

Milk-testing at cheese factories (*Die Milchuntersuchung in der Käserei*).—*Milch Ztg., 1892, pp. 689–691.*

Cheese-making in southern Holland (*Käsebereitung in der Provinz Südholland*), B. ROST.—*Molk. Ztg., 1892, pp. 554, 555.*

Coöperative creameries in Austria (*Die Molkerei-Genossenschaften in Oesterreich*), C. SITTER.—*Milch Ztg., 1892, pp. 709–712.*

The Swiss dairy schools (*Ueber schweizerische Molkerei-Schulen*), A. NENTWIG.—*Molk. Ztg., 1892, pp. 541, 542, 553, and 554.*

Irrigation canals of the Rhone (*Les canaux d'irrigation du Rhône*), CHAMBRELENT.—*Compt. rend., 115 (1892), No. 17, pp. 576–581.*

EXPERIMENT STATION NOTES.

ALABAMA COLLEGE AND STATION.—C. A. Cary has been appointed professor of veterinary science in the college. A. F. Cory has been appointed to aid in carrying on coöperative soil tests planned by the station.

CALIFORNIA STATION.—Numerous analyses of fruits and wines have been made at the station during the past season. Propagating houses for experimental purposes have been erected at the outlying stations. In view of the constantly increasing importance of olive culture in California, experiments in oil-making with the different varieties of olives growing in the State are to be undertaken at the station. The experiments will be under the immediate charge of L. Paparelli. Machinery representing the latest and most approved methods of oil-making as carried on in southern Europe has been secured. During the present season work in this line will be confined to testing the machines. The following authorized account of the machines was published in the *Pacific Rural Press* of November 12, 1892:

"*The pitter.*—It has been known for a long time that an extra quality of the oil is obtained from the flesh of the olive without the pit. Such oil is superior both for its delicacy and for its resistance to rancidity. Palladius recommended the practice of pitting to the old Greeks and Pliny to the Latins. The old Romans also had the same conviction, as has been confirmed from the old oil mill found at Stabia. Sieuve and Stanchowich at the beginning of this century had the same opinion and ordered special apparatus for the purpose, but it has been only in these latter years that great attention has been given to this matter. Several competitive prizes were established by the governments and societies for southern European countries for the manufacture of olive pitters. At present it seems that the best pitter is that devised by Mr. Salvatella of Tortosa, Spain, one of which has been purchased for work at the university.

"Salvatella's pitter has a hopper, which distributes the olives to the cylinders in the interior of the machine. These cylinders, by a special arrangement, separate the flesh entirely from the pit without breaking the latter. Flesh and pits of the olives thus obtained are gently pressed to extract the virgin, the best quality of oil of the fruit, and afterward the pomace is introduced into the 'crusher' mentioned below, in which it is converted into a very fine mash, from which, being pressed again, we obtain the rest of the oil contained in the fruit. Of course this oil is of a second quality.

"The pitter may be worked by hand or by horse or steam power. When horse power is used, the pitter works 45 gallons of olives per hour. The same power is sufficient to operate two machines.

"The importance of this machine is such that it should be recommended to all those who want to economize capital and labor, while obtaining a product of high quality, commanding the highest prices on the market.

"*The crusher.*—This machine, manufactured also by Salvatella, crushes the olives between two grooved cylinders, either in the fresh or in the dry state. Both flesh and pits are reduced in a short time into a very fine paste. It has in one side two adjusting screws for the cylinders, in order to regulate the fineness of the paste. When the machine is in operation a vibrating cleaner separates the largest part of residues of stems and leaves, sand, and other impurities that may be with the olives.

"Like the pitter, the work with the crusher is very easy. It occupies a space of about 3 square feet and weighs about 660 pounds. It may be operated by hand or

by horse or steam power. Its work is at the rate of about 45 gallons of olives per hour. The same power may do for two crushers, thus saving much time and money.

"If only a second quality of oil is desired, the crusher is sufficient without the pitter. The frames of both the pitter and the crusher are of iron.

"*The press.*—This has been made by Toulouse and Delorieux, and is a good specimen of the best type of screw presses now used in olive-growing countries. It is small, but possesses a fair working capacity. It covers barely 2 feet square space, and is said to weigh about 1,500 pounds, the working mechanism included. With such a compact and comparatively light construction one would naturally class it among presses of low power, yet it is estimated that owing to a clever combination of levers, with which it is provided, one man using a lever handle of 2 feet stroke can obtain with it a pressure of 40 tons, which is sufficient for our purpose. The body of the press comprises merely a cast-iron base, two posts rising from opposite sides thereof, and a crosspiece uniting these posts at their upper end. In the center of the base, which stands about a foot high, is placed a sheet-iron basket with perforated sides (that can be opened in two halves), into which the product from the pitter or from the crusher is put for pressing, and all around this is a deep groove, through which the expressed oil flows out to spouts or discharge openings to be found on opposite sides midway between the posts. The pressing is done by means of a follower entering the perforated basket from above and carried by a vertically movable screw fitted in a nut or threaded sleeve formed in the central part of the crosspiece which joins the posts together. The screw, and consequently the follower, is moved to effect the pressing through the medium of a mortise wheel firmly keyed to its upper end and a slotted collar having cotter keys or gravitating catches adapted to successfully engage the mortises in this wheel. Movement is imparted to this mechanism by a short lever formed integral with the collar and swung back and forth. Below this lever is another one adapted to work in connection with it and multiply the power. This second lever is pivoted to a short bracket projecting from the upper crosspiece of the press. The two levers when used together are coupled by a frictional pin seated in the lower lever and playing within a slot in the upper. The press has thus movements of two powers, one produced by a single lever acting directly upon the collar and through it and the gravitating catches upon the mortise wheel carried by the screw, the other by the same mechanism actuated by two levers coupled by a frictional pin. The speed of course is in inverse ratio to the power developed. If rapid movement is wanted, the single lever is used; if power is the object, both levers are called into action."

MARYLAND COLLEGE AND STATION.—R. W. Sylvester has been appointed president of the college and R. H. Miller director and agriculturist of the station. The other members of the station staff are, H. J. Patterson, chemist; J. S. Robinson, horticulturist; E. H. Brinkley, machinist; and J. R. Owens, treasurer.

NEBRASKA STATION.—F. S. Billings is giving a course of lectures at the Chicago School of Veterinary Medicine. Bulletin No. 25, on detasseling corn, by C. L. Ingersoll, will be issued in December. Bulletin No. 26, on meteorology at the station, is in course of preparation.

NORTH CAROLINA STATION.—R. E. Noble of the Alabama College Station has been appointed assistant chemist vice T. L. Blalock.

NORTH DAKOTA STATION.—E. S. Keene has been appointed agricultural engineer, with a view to having investigations of farm machinery conducted at the station. The first work will be on a stubble burner for removing all straw from the soil after harvesting, thus doing away with the necessity of annual plowing for wheat.

PENNSYLVANIA COLLEGE AND STATION.—H. B. Gurler has been appointed instructor in butter-making for the special course in dairying, which opens January 4, 1893. W. H. Caldwell, assistant agriculturist, has been selected by the American Guernsey Cattle Club to take charge of the Guernsey cows entered for the test of dairy breeds at the World's Columbian Exposition.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

OCTOBER, 1892.

DIVISION OF STATISTICS:

Report No. 99 (new series), September and October, 1892.—Farm Prices in Two Centuries; Report of Ramie Machine Trials in New Orleans; Indian Wheat Crop of 1892; Notes on Domestic and Foreign Trade and Industry; European Crop Report for September; Freight Rates of Transportation Companies.

Report on Condition of Crops, October, 1892.

Spanish edition of Report on the Use of Corn in Europe.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. IV, No. 1.

WEATHER BUREAU:

Monthly Weather Review, July, 1892.

Monthly Weather Review, August, 1892.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

OCTOBER, 1892.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 38, July, 1892.—Fertilizers.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 112, June, 1892.—On the Gunning-Kjeldahl Method and a Modification Applicable in the Presence of Nitrates.

DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 18, September, 1892.—Strawberries, Tests of Varieties; The Strawberry Weevil.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Special Bulletin D, February, 1891.—Composition of Commercial Fertilizers Sold in the State.

Special Bulletin E, August, 1891.—Composition of Commercial Fertilizers Sold in the State.

Special Bulletin H, July, 1892.—Government Direction of Agriculture in Europe.

Special Bulletin I, August, 1892.—Composition of Commercial Fertilizers Sold in the State.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:
Circular, May, 1891.—Analyses of Commercial Fertilizers.
HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:
Meteorological Bulletin No. 45, September, 1892.
EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:
Third Annual Report, 1890.
Fourth Annual Report, 1891.
MISSOURI AGRICULTURAL COLLEGE EXPERIMENT STATION:
Bulletin No. 18, August, 1892.—Strawberries.
AGRICULTURAL EXPERIMENT STATION OF NEW MEXICO:
Bulletin No. 6, March, 1892.—Cereals, Forage Plants, Grasses, Clovers, Textile Plants, and Sorghums.
NEW YORK AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 45 (new series), August, 1892.—Experiments in the Manufacture of Cheese during June.
NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 7, September, 1892.—Rheumatism in Horses.
OHIO AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 44, September, 1892.—A Preliminary List of the Rusts of Ohio Wild Lettuce; a Pestiferous Weed; Wheat Scab.
OKLAHOMA AGRICULTURAL EXPERIMENT STATION:
Special Bulletin No. 1, October, 1892.—Texas Cattle Fever.
PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 21, October 1892.—The Koch Test for Tuberculosis.
TEXAS AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 21, June, 1892.—Effect of Cotton Seed and Cotton-Seed Meal in Feeding Hogs.
AGRICULTURAL EXPERIMENT STATION OF UTAH:
Bulletin No. 17, October, 1892.—Feeding Root Crops *vs.* Dry Food.
Bulletin No. 18, October, 1892.—Notes on Forest and Fruit Trees.
VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE EXPERIMENT STATION:
Bulletin No. 18, July, 1892.—Antiseptics in Relation to the Treatment of Wounds.
Bulletin No. 19, August, 1892.—Tests of Varieties of Wheat.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:
Annual Report, 1891.
Bulletin No. 14, September, 1892.—The Horn Fly.

EXPERIMENT STATION RECORD.

VOL. IV. DECEMBER, 1892. NO. 5.

In the development of American educational and scientific institutions, there has been in recent years a marked improvement in the technical training of the men employed as teachers and investigators. In most cases, however, the territory tributary to individual institutions is so large that it has seemed to them desirable to provide for work in as many general lines as practicable. The result has been that while many colleges and universities are fairly well equipped as regards the requirements of general courses of instruction, very few have been able to devote a sufficient portion of their resources to securing complete facilities for work in special lines. When a young man has gone through the ordinary training of the college and university and desires to pursue some specialty, he is compelled, as a rule, to cross the Atlantic to find such opportunities for instruction as he requires. What is true of our educational system broadly considered is also true of our institutions for education and research in agriculture. Until the organization of the experiment stations under the act of Congress of March 2, 1887, there was very little demand in this country for advanced instruction in special branches of agricultural science. Men with special training employed as teachers in the agricultural colleges found themselves compelled to do a large amount of routine work with undergraduate students, and deemed themselves fortunate if they were able to give any attention to original researches in their specialties. The establishment of the stations throughout the United States has materially increased the amount of original investigation in agricultural science, given better opportunities to well-trained specialists, and created a demand for higher instruction in the agricultural colleges. As yet, however, the public have not fully realized the necessity for long-continued and thorough investigations of agricultural problems, and the stations have been called upon to do a vast amount of general work, which, though often useful, has prevented as much attention to the more serious problems as is essential for their solution. Fortunately the agricultural colleges have received large additions to their equipments and incomes through the liberality of the State and

National Governments, and are adding new courses of instruction, which we have reason to expect will be manned by competent teachers.

It is therefore in many respects a favorable time to urge that as changes are made in the scheme of work of our colleges and stations, they should be in the direction of more thorough specialization. That this may be most economically done we must rid ourselves of the idea that each State must necessarily have all the "ologies" within its borders. What is needed is to have the best facilities for work in any given line provided somewhere in the United States. The advanced students whose interests are concerned in this matter will not hesitate to cross State lines if they can only be assured that the institution attracting them will really meet their needs in the quality of its instruction.

When an institution already fairly equipped for general instruction, has received an addition to its income, it has been a common plan to expand its work in several lines. The new resources are readily expended in providing assistants and apparatus in this and that department. In this way the general efficiency of the institution may be increased, but after all its position in the educational world will remain about what it was before. The question we wish to raise is whether it would not be a wiser plan to take sufficient funds for the manning and equipment of some one line of work to provide the best possible facilities in that line. Let New York, for example, lay so much stress on certain branches of horticulture that everybody desiring advanced instruction in those branches will see that there is the place to get it. Wisconsin might do the same in swine husbandry, Illinois in corn culture, Louisiana in sugar culture and sugar-making, California in soil investigations, and so on through the list of States and institutions. Such a plan would not in any way interfere with the ordinary courses of instruction for undergraduate students in the agricultural colleges. It would, on the other hand, enable the respective institutions to provide the most complete equipments for special investigations and encourage men of ample technical training to devote themselves to the most thorough research. With proper provisions for the distribution of the reports of important inquiries throughout the country, much more satisfactory results would be obtained than are possible as long as each institution attempts to cover a wide range of subjects. Division and combination of labor will prove as economical and productive in agricultural laboratories as in manufacturing establishments.

SIXTH ANNUAL CONVENTION OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The Association of American Agricultural Colleges and Experiment Stations held its sixth annual convention November 15–19 at New Orleans, Louisiana, in the lecture hall of Tulane University. There were present nearly one hundred and fifty delegates and representatives of colleges and stations in all the States and Territories except Idaho, Montana, Oregon, South Dakota, and Virginia, and of the U. S. Departments of Agriculture and the Interior. The unusually large attendance of members of the governing boards of colleges and stations was especially gratifying.

On assembling for its first session, the Association was very cordially welcomed to New Orleans in addresses by Governor M. J. Foster, of Louisiana; Mayor J. Fitzpatrick, of New Orleans, and President W. P. Johnston, of Tulane University. Appropriate responses were made by President W. LeRoy Broun, of Alabama; President George W. Atherton, of Pennsylvania, and Judge H. Chamberlain, of Michigan. The annual address of the president of the Association, W. LeRoy Broun, of the Agricultural and Mechanical College of Alabama, presented suggestive comments on the work of the colleges and stations. The hopeful outlook for the system of technical education represented by the land grant colleges was clearly portrayed. These institutions should not be narrow in their aims. They are intended for all the industrial classes. It is their function to produce men with trained brains and hands. They are to teach the *why* as well as the *how*. They are not to abridge the opportunity to choose an occupation, but to enable the student to prepare for the life for which he is best adapted. The value of military training as a part of the education of the citizen was insisted on. The investigations of the experiment stations and the dissemination of information to the masses of farmers through bulletins and institutes were shown to be increasingly valuable parts of the American plan for the education of the industrial classes.

The convention gave a large share of its time to discussions regarding means for making the colleges more effective in educating men for practical work on the farm. Attention was first drawn to this subject by the report of the committee on college work, read by E. M. Turner, of West Virginia. This indicated that while there was an increase in

the number of students and graduates, this was due largely to the increase in the number of students in the courses in the mechanic arts. In the discussion which followed it was urged by some that the standard of admission to the courses in agriculture was too high, and that too little practical instruction was given. To remedy this, shorter courses of instruction and courses in special subjects were advocated. Prof. Henry, of Wisconsin, urged that instead of one professor of agriculture in each institution there should be a number of thoroughly trained specialists in different branches of agriculture, so that the farmers' sons would be impressed with the practical as well as the scientific value of the instruction they received. Attention was also called to the fact that by graduating investigators and teachers in the sciences related to agriculture and leaders in the practice of advanced methods of agriculture the colleges were doing a grand work. Since they were organized under law as institutions for higher education they could not be expected to directly reach the masses of farmers. Through the bulletins of the experiment stations, the farmers' institutes, and the agricultural press the men educated in these colleges were doing the highest kind of service for the advancement of agriculture.

President G. T. Fairchild, of the Kansas College, read a paper on the relations of technical to general courses of study. To avoid too great narrowness and a separation of culture from technical training, the system of education should have the single aim of imparting knowledge with reference to its usefulness to humanity. Such a scheme involves the teaching of accurate speech, reckoning, reasoning, elementary analysis of the universe, morals, and history, as related to every-day life. At the Kansas College pupils are admitted from the country schools, and are given instruction in natural science, mathematics, surveying, engineering, agriculture, and mechanical arts. They are taught to think along the line of various industries. Every effort is made to interest students in the practical work of life.

In the section on agriculture and chemistry W. M. Hays read a paper on the details of successful farm education, in which he described the two years' school course, the dairy course, and the farmers' winter course of the University of Minnesota. The school of agriculture, which has now been in operation more than four years, has proved a great success. In this school about half the time of the students is given to academic studies, and the rest to agriculture, horticulture, veterinary science, carpentry, and other manual work. The boys go back from this school to the farm. As a result of its establishment the farmers of the State have taken a much larger interest in education in agriculture. The separation of this lower course of instruction from the regular college course makes it possible to raise the standard of the latter at the same time that it affords an opportunity for practical instruction to a great number of students.

What a professor of agriculture should be required to teach, was discussed by G. E. Morrow, of Illinois, and P. M. Harwood, of Michigan.

Both believed that he should teach the application of science rather than science itself. He should, in general, give instruction on (1) farm equipment, (2) farm processes, and (3) farm management. Advantage should be taken of interesting current events in agriculture to stimulate the interest of the pupil. Prof. Harwood insisted upon the value of manual labor in connection with courses of instruction. The student, however, should be made to feel that he is working not as a drudge, but as a learner of valuable processes. Giving the student laborer charge of some special piece of work will do much to arouse his enthusiasm.

Among the papers read in the general sessions or in the sections were the following:

Experiments with fungicides for apple scab, by E. S. Goff, of Wisconsin.—As a result of seven years' work with various fungicides, Bordeaux mixture is deemed on the whole most effective. It is sufficient to use the solution in one half its usual strength. The first spraying should be made before the opening of the flowers. The number of sprayings will vary with climatic conditions. The use of fertilizers and good culture will help to reduce the amount of scab. Some varieties of apples seem to be less liable to injury by this disease.

Fungicides for potato blight and rot, by L. R. Jones, of Vermont.—An account of experiments the present season with twelve different fungicides on medium and late potatoes of 5 varieties. The fungicides preserve the foliage and thus help the crop to come to maturity. The disease was very prevalent and the gain from the use of the fungicides was large. The best results were obtained with Bordeaux mixture, full strength.

A study of fruit rots, by B. D. Halsted, of New Jersey.—With the aid of a diagram the author showed a method of illustrating how diseases are transferred from one kind of fruit to another. His studies on the genus *Glœosporium* have brought out more clearly the relations of the different forms and point to the fact that there are fewer distinct species than was formerly supposed.

Notes on the breeding of fruits, by N. E. Hansen, of Iowa.—An account of experiments in crossing varieties from eastern Europe with standard or native varieties.

Crossing of cucurbits, by L. H. Pammel, of Iowa.—This was a preliminary report on experiments by the author, the results of which in general indicate that the different species will not mix.

Forage plant tests, scope and plan, by C. C. Georgeson, of Kansas.—An account of experiments at the Kansas Station. The report was very favorable to soja beans in a dry climate like that of Kansas.

Methods of soil analysis, by E. W. Hilgard, of California.—This paper was read by R. H. Loughridge, and pointed out the differences between the methods of soil analysis as proposed by Prof. Kedzie and as followed by Prof. Hilgard. The main differences were, (1) in the size of the meshes used, (2) in the degree of dryness of the sample, (3) hygro

scopic moisture, and (4) time of digestion. The details of Hilgard's method were given and the churn elutriator used by Hilgard was shown. It was recommended that this apparatus be adopted by the stations in their work. This paper was referred to the executive committee of the Association of Official Agricultural Chemists, with the request that comparisons be made between Kedzie's and Hilgard's methods.

Bean anthracnose and its treatment, by S. A. Beach, of New York.—An account of experiments with various fungicides. The advantage of using healthy seeds was clearly shown in the tests made.

Some experiments in the prevention of Cercospora ribis and Cylindrosporium padi, by L. H. Pammel.—Experiments were reported which showed the value of Bordeaux mixture in the treatment of these diseases.

Antagonistic relations of certain potato rots, by L. R. Jones.—Three forms of potato blight and rot are common in Vermont. *Phytophthora infestans* does its greatest damage to medium and late potatoes. A "new disease" destroys the potato vines by the first week in August, before the climatic conditions were such as to favor the development of *Phytophthora infestans*.

Preliminary notes on a ruta-baga and turnip rot, by L. H. Pammel.—A disease, thought to be due to a bacterium, did considerable damage to ruta-bagas and turnips at the Iowa Station the past season. Several germs were isolated, one of which apparently produces the disease in the field. The evidence thus far obtained is, however, not conclusive.

A new damping-off fungus, by G. F. Atkinson, of New York.—A sterile mycelium of a fungus which causes damping-off of cotton, cowpeas, cauliflower, alfalfa, etc., was isolated. The fungus was grown in nutrient media and young plants were inoculated, which produced the characteristic damping-off. From these plants the fungus was again obtained. It is probably a species of *Hymenomycetes* or *Discomycetes*.

Relation of frost to certain plants, by L. H. Pammel.—In this paper the exact temperatures at which various plants were affected by frost were noted. In some cases the parts of a plant close to the ground were affected, while its upper parts were not injured. For example, in the case of the castor-oil bean (*Ricinus communis*), on October 18 the minimum temperature close to the ground was 18° F., while 5 feet higher it was 36°.

Method of obtaining pure cultures of Pammel's fungus of Texas root rot of cotton, by G. F. Atkinson.—This is a difficult fungus to grow in nutrient media. When grown in moist sand the strands developed to several inches in length, but they failed to grow in nutrient media when transferred. Baits were provided and after some difficulty the fungus was obtained in a pure state.

Quince diseases, by B. D. Halsted.—The following fungous troubles of the quince fruit were treated: Quince rust (*Ræstelia aurantiaca* Pk.),

fruit spot (*Entomosporium maculatum* Lev.), black rot of quince (*Sphæropsis malorum* Pk.), quince pale rot (*Phoma cydoniæ* Sacc.?), ripe rot of the quince (*Glœosporium fructigenum* Berk.), and the quince blotch, due to an unrecorded fungus, the life history of which is still obscure. The black rot is the same as that of the apple, and the fact that a large apple tree near the quince bushes experimented with had the ground beneath it covered with rotting apples doubtless had much to do with the prevalence of the rot in the quinces. The pale rot may not be *Phoma cydoniæ* Sacc., the description being so meager as to leave a doubt. The ripe rot is the same as that of the apple, as proved by inoculation.

New Jersey mildews (*Peronosporeæ*), *by B. D. Halsted.*—The chief point in the record for the year is that while the latter portion of the growing season has been unusually dry there has been more than an ordinary amount of those members of the group belonging to the genus *Cystopus*. In a further study of the methods these disastrous mildews have for passing the winter it was found that some species grow upon the fruits and that doubtless the filaments of the fungus penetrate the seeds and when the latter germinate the parasite develops with the host. Large numbers of small young seedlings were taken which were badly infested.

The importance of making field notes upon the prevalence of parasitic fungi extending over many seasons was urged.

Weed seeds, by B. D. Halsted.—Samples of a collection of weed seeds were shown. The set consists of one hundred species of our worst weeds, and the seeds are put up in dram metal screw-top vials arranged in a tray about the size of a herbarium sheet. Each bottle has a printed label bearing a number and the botanical name of the seeds contained. To the inside of the tray cover is pasted a corresponding list with common names added and a note stating whether the species is native or foreign, and whether annual, biennial, or perennial. The set is designed to assist experiment station workers in determining the nature of impurities in commercial seeds. It will also serve the same purpose for the wholesale dealers in seeds.

The field of bulletins present and prospective, by C. L. Ingersoll, of Nebraska.—Bulletins should be so simple that the most ignorant farmer can get some good from them. Graphic illustrations should be used. Each bulletin should be complete in itself. The results of experiments should be briefly summarized. Full data should not be given in bulletins intended for the farmer. Objections were raised to this last point and it was suggested that the full data be put in an appendix.

The numbering of station bulletins was discussed by A. W. Harris, W. A. Henry, S. W. Johnson, and others. The great desirability of some simple and uniform plan of numbering the station publications was urged. The consecutive numbering of all ordinary bulletins in a single series and the abandonment of special series, half num-

bers, and letters was advised. A committee was appointed to make definite suggestions to the stations regarding this matter.

The relations of the colleges and the Department of the Interior were discussed in a paper by J. W. Holcombe, chief clerk of the Bureau of Education. Attention was called to the fact that the present schedule for financial reports of the colleges was not satisfactory.

The report of the executive committee was read by H. E. Alvord, and showed that the committee had done efficient service in connection with the work on the college and station exhibit at the World's Columbian Exposition and on other important matters.

In the report of the section on agriculture, presented by C. L. Ingersoll, the bulletins of the year were classified. They showed a wide range of subjects, largely along practical lines, but also indicated that the mistake is often made of trying to settle too many questions in a single experiment.

The report of the section on botany, prepared by G. F. Atkinson, was read by S. M. Tracy. During the year botanists have been added to the station staffs at five stations. A general survey of the work occupying the attention of botanists at the different stations was made. The belief was expressed that bacterial plant diseases offered one of the most promising fields of investigation.

The report of the section on chemistry was presented by M. A. Scovell, of Kentucky. It was shown that the work of the station chemists includes (1) detective work, (2) work relating to farm management, (3) development or improvement of processes, (4) more strictly scientific investigations. While a very large amount of routine work is being done a number of important scientific researches are in progress.

The report of the section on economic entomology, presented by H. Osborn, of Iowa, related to the equipment of the stations for work in this line.

The report of the committee on the college and station exhibit at the World's Columbian Exposition was presented by H. P. Armsby and H. E. Alvord. This showed that while much progress had been made in the preparation for the exhibit, it was still necessary that the several stations should contribute time and money to this enterprise to make it thoroughly successful. The outlook for a creditable exhibit was decidedly encouraging.

The agricultural congresses to be held in connection with the World's Columbian Exposition were described by G. E. Morrow, and the colleges and stations were urged to coöperate.

President Smart called attention to the difficulty attending the collection of intercollegiate statistics. A committee was appointed, consisting of George W. Atherton, J. H. Smart, and H. H. Goodell, to prepare a schedule of questions to be sent to the colleges.

A new constitution for the Association, prepared by the committee appointed for that purpose at the last convention, was adopted, with

amendments. In the new constitution the following sections are provided for: (1) College work, (2) agriculture and chemistry, (3) horticulture and botany, (4) entomology, (5) mechanic arts. A bibliographer is added to the officers of the Association.

An advisory board of nine members, selected from governing boards of the colleges and stations, was appointed to coöperate with the standing committees on the World's Columbian Exposition. The members of this committee are H. Chamberlain, of Michigan; J. A. Beaver, of Pennsylvania; H. Gibson, of Kentucky; R. H. Warder, of Ohio; W. R. Cavitt, of Texas; W. L. Rynerson, of New Mexico; J. R. Cameron, of Mississippi; D. Needham, of Massachusetts, and H. B. Dale, of Wisconsin.

A committee to represent the Association on the testing committee for tests of breeds of dairy cows at the World's Columbian Exposition was constituted as follows: M. A. Scovell, I. P. Roberts, S. M. Babcock, and H. P. Armsby.

The following were elected officers of the Association for the ensuing year: President, W. A. Henry, of Wisconsin; vice-presidents, W. C. Stubbs, of Louisiana; E. W. Hilgard, of California; J. A. Myers, of West Virginia; A. Q. Holladay, of North Carolina, and J. F. Hickman, of Ohio; secretary and treasurer, M. A. Scovell, of Kentucky; bibliographer, S. W. Johnson, of Connecticut; executive committee, H. E. Alvord, of Washington, D. C.; W. L. Broun, of Alabama; J. Neilson, of New Jersey; H. H. Goodell, of Massachusetts, and C. W. Dabney, jr., of Tennessee.

Section on college work.—Chairman, C. W. Dabney, of Tennessee; vice-chairman, G. T. Fairchild, of Kansas; secretary, M. C. Fernald, of Maine.

Section on agriculture and chemistry.—Chairman, W. A. Henry, of Wisconsin; vice-chairman, W. C. Stubbs, of Louisiana; secretary, W. C. Latta, of Indiana.

Section on horticulture and botany.—Chairman, F. Lamson-Scribner, of Tennessee; secretary, E. S. Goff, of Wisconsin.

Section on mechanic arts.—Chairman, C. W. Hall, of Minnesota; secretary, F. P. Anderson, of Kentucky.

On the invitation of Director Stubbs the Association visited the Sugar Experiment Station at Audubon Park, New Orleans. The sugarhouse was in operation and the processes of making sugar by the diffusion method were explained. The experimental plats where varieties of sugar cane, cotton, grasses, and other plants are being tested, and where experiments in methods of culture and manuring are in progress, were also examined with great interest, as well as the orange orchard and other fruit plantations. The system of drainage and irrigation at the station is such that the conditions of soil moisture are very largely under the control of the experimenter.

Through the liberality of the Illinois Central Railroad Company the Association enjoyed a visit to the cane fields and sugar mills between New Orleans and Baton Rouge. At Baton Rouge the Association was given a dinner by the citizens, after which a visit was paid the State University, where they were cordially welcomed by the president, J. W. Nicholson, and the battalion of cadets. Addresses expressing the appreciation of the Association for the kindly treatment received were made by several members. The citizens of New Orleans also gave the Association a trip on a Mississippi River steamer, which enabled them to form some idea of the vast commerce of this city in sugar, cotton, wheat, and other agricultural products. The exports of wheat from this port have so largely increased in recent years that they are now greater than those of any other American city, with the exception of New York.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

METEOROLOGY.

Rainfall at Iowa Station, E. N. EATON (*Iowa Sta. Bul. No. 18, Aug., 1892, p. 531*).—Tabulated summary for March, April, May, June, and July.

Meteorological observations, C. D. WARNER (*Massachusetts Hatch Sta. Meteorological Bul. No. 45, Sept., 1892, pp. 4*).—Daily and monthly summaries of observations during September, 1892, at the meteorological observatory of the station.

Meteorological observations, R. C. KEDZIE (*Michigan Sta. Reports for 1890 and 1891, pp. 153–177 and 98–122*).—Tabulated results of daily observations at the station of temperature, pressure, humidity, cloudiness, precipitation, etc., for each month of the years 1889 and 1890. The annual summaries are as follows: *Air temperature* (degrees F.).—Mean daily, 1889, 47.43; 1890, 47.61. *Humidity*.—Mean relative humidity, 1889, 74; 1890, 75.98. *Pressure* (inches).—Aqueous vapor, 1889, 0.273; barometric pressure, 1889, 29.073; 1890, 29.095. *Weather*.—Cloudiness (per cent), 1889, 56; 1890, 55.25; number of thunderstorms, 1889, 7; 1890, 12. *Precipitation*.—Total (inches), 1889, 23.78; 1890, 31.91; snow fall, 1889, 37.5; 1890, 14.75.

SOILS.

W. H. BEAL, *Editor*.

Soil temperatures, R. C. KEDZIE (*Michigan Sta. Reports for 1890 and 1891, pp. 143–152 and pp. 92–97*).—Tabulated results of tri-daily observations at depths of 3, 6, 9, 12, and 24 inches, during the period of May–September, 1890, at Lansing and Grayling, Michigan, and of May–October, 1891, at Lansing.

FERTILIZERS.

W. H. BEAL, *Editor*.

Composition of commercial fertilizers (*Maryland Sta. Special Buls. D, E, and I, Feb., 1891, Aug., 1891, and Aug., 1892, pp. 11, 8, and 8*).—Tabulated analyses of 171 samples of commercial fertilizers sold in Maryland, with notes on valuation.

Analyses of fertilizers, C. A. GOESSMANN (*Massachusetts State Sta. Circular, May, 1891, pp. 4*).—Tabulated analyses of 36 samples of fertilizing materials, containing mixed fertilizers, wood ashes, and cotton-hull ashes, with remarks on valuation.

FIELD CROPS.

A. C. TRUE, *Editor*.

Experiments with wheat at Kansas Station, C. C. GEORGESON, F. C. BURTIS, and W. SHELTON (*Kansas Sta. Bul. No. 33, Aug., 1892, pp. 50*).

Synopsis.—The experiments with wheat in 1892 were on the following subjects: (1) Continuous cropping without manure, (2) rotations, (3) seeding at different times, (4) immature *vs.* mature seed, (5) methods of seeding, (6) effects of pasturing, (7) seeding at different rates, (8) weight of seed, (9) test of varieties. Most of this work was in continuation of that recorded in Bulletin No. 20 of the station (E. S. R., vol. III, p. 223). The average yield of grain during ten years on plats cropped continuously with wheat has been 28.57 bushels. The results in other lines favor early fall seeding, mature seed, seeding with shoe drill, not pasturing, not less than 2 bushels of seed per acre, and heavy and plump seeds. During four years Currell, Zimmerman, and Red May varieties have given the largest yields of grain.

In the experiments reported in this bulletin Currell wheat was used instead of Zimmerman as heretofore. The climatic conditions were generally favorable. "All the seed was treated with hot water as a preventive of stinking smut, with entire success."

Wheat continuously without manure (pp. 2, 3).—The yields of wheat on an acre are tabulated for each year since 1880. Excluding two years when the crop was winterkilled, the average yield per acre has been 28.57 bushels. In 1892 the yield was 31.3 bushels.

Wheat in rotation (pp. 3–6).—The rotations planned to continue from 1890 to 1902 are tabulated in detail, together with the yields of grain and straw on the plats devoted to wheat during the past three years (1890–'92). The rotations are ten in number, each being repeated on 5 tenth-acre plats.

Wheat, seeding at different times (pp. 7, 8).—Notes and tabulated data for an experiment in which wheat was seeded at six different dates between September 10 and October 30. The average results were as follows:

Average yield of wheat per acre from seeding at different dates.

Time of seeding.	Grain.	Straw.
	Bushels.	*Tons.*
Sept. 10	23.34	1.08
Sept. 21	21.71	0.99
Sept. 30	21.28	0.87
Oct. 10	21.66	0.93
Oct. 20	15.56	0.71
Oct. 30	7.53	0.36

Wheat from immature vs. mature seed (p. 8).—A brief account of an experiment on 2 tenth-acre plats, on which ripe seed was compared with that from wheat cut while in the milk. The immature seed yielded 19.75 bushels of grain and 0.80 ton of straw, the mature seed 22 bushels of grain and 1.04 tons of straw. The difference in favor of mature seed was more pronounced than in a similar experiment the previous year.

Wheat, methods of seeding (pp. 8-10).—The methods tested in 1892 were, seeding (1) broadcast, (2) with roller drill, (3) with shoe drill, and (4) with lister. The yields of grain and straw on each plat are tabulated, and the average yield per acre for each method in 1892 and during two years are compared.

Average yield of wheat from different methods of seeding.

Method of seeding.	1891.		In two years.	
	Grain.	Straw.	Grain.	Straw.
	Bushels.	*Tons.*	*Bushels.*	*Tons.*
Roller drill	23.78	1 07	28.17	1.61
Shoe drill	27.63	1.33	29 76	1 68
Broadcast	24.03	1.22	28.41	1.65
Listed	27.03	1.24	28.19	1.39

Wheat, effects of pasturing (pp. 10, 11).—The yields of grain and straw are tabulated for 15 twentieth-acre plats, 5 of which were pastured, 5 rolled, and 5 neither pastured nor rolled. On each of the pastured plats a dairy cow was allowed to feed for five hours a day on April 6, 7, and 9. The average yields per acre were as follows:

Average yield of wheat from pasturing and not pasturing.

Method of seeding.	1892.		In two years.	
	Grain.	Straw.	Grain.	Straw.
	Bushels.	*Tons.*	*Bushels.*	*Tons.*
Spring pastured	33 03	2.12	29.08	1.66
Rolled	38.15	2.00	....	....
Not pastured	38.06	1.91	32 31	1.56

Wheat, rate of seeding (pp. 11-13).—Tabulated yields of grain and straw on 35 twentieth-acre plats seeded at rates of from 2 to 8 pecks per acre. The average yields for the different rates were as follows:

Average yield of wheat from seeding at different rates.

Rate of seeding.	Grain.	Straw.
	Bushels.	*Tons.*
2 pecks	20.46	1.18
3 pecks	31.83	1.75
4 pecks	34.76	2.13
5 pecks	35.05	1.76
6 pecks	36.99	1.87
7 pecks	36.16	2.06
8 pecks	37.91	2.17

Wheat, weight of seed (pp. 13, 14).—Tabulated yields of grain and straw on 12 plats seeded with seed weighing 64½, 62¼, and 60⅞ pounds

per struck bushel. The yields of grain per acre in 1892 averaged 28.88, 28.60, and 27.37 bushels, respectively. For two years, in which the weights of the different kinds of seed varied somewhat, yields of grain per acre averaged 31.90 bushels from "heavy" seed, 31.13 bushels from "common" seed, and 30.03 bushels from "light" seed.

Wheat, test of varieties (pp. 14–50).—Notes on the results obtained with each of 236 varieties tested in 1892, with comparative yields in previous years. The following varieties, tested four years, have given an average yield of more than 30 bushels per acre: Badger 30.58, Buckeye 33.76, Currell 39.61, Extra Early Oakley 34.68, Nigger 32.22, Red May 36.07, Reliable 31.71, Tasmanian Red 35.04, Tuscan Island 30.15, and Zimmerman 37.53.

The following varieties, tested two years, have given an average yield of more than 35 bushels per acre:

Andrews No. 4	49.72	Jennings	35.12
Ashburn	36.29	Lancaster	37.79
Bearded Monarch	41.21	Lehigh	40.26
Big English	35.50	Lehigh No. 6	36.73
Big Frame	37.75	Manitoba	35.31
Big May	35.50	McCracken	39.78
Boyer	42.15	McPherson	48.47
Bullard Velvet Chaff	35.45	Michigan White	38.92
California Blue Stem	41.41	Miller	37.88
Canadian Wonder	39.95	Oregon Club	35.06
Dallas	40.47	Patagonia Trigo	36.68
Davis	37.36	Penquite Velvet Chaff	41.51
Deitz	38.48	Powers	37.35
Democrat	40.73	Purple Straw	36.82
Diehl-Egyptian	38.38	Ramsey	42.70
Diehl-Mediterranean	40.43	Red Cross	36.29
Egyptian	36.57	Red Fultz (Kansas)	39.27
Emporium	43.38	Red Fultz (Ohio)	41.15
Farquhar	37.54	Scott	36.09
Finley	35.93	Seneca Chief	35.48
Fulcaster	37.74	Strayer Egyptian	38.01
Fultz	38.46	Strayer Longberry	36.01
Geneva	35.34	Valley	40.56
German Emperor	35.21	Velvet Chaff	37.17
Gold Medal	38.21	Wayne County Select	36.63
Half Beard	36.95	White Blue Stem	39.69
Height Prolific	40.26	White Track	35.97
Hindostan	40.24	Yellow Alabama	37.17
Hybrid No. 9	36.29		

Wheat, milling and baking tests, D. N. HARPER (*Minnesota Sta. Bul. No. 23, Sept., 1892, pp. 141–146*).

Synopsis.—Notes and tabulated data on milling and baking tests of wheat of the following kinds: Pure Scotch Fife; pure Blue Stem; pure Ladoga, and Scotch Fife threshed while wet, slightly bleached, slightly frosted, badly frosted, and badly bleached. Pure Scotch Fife proved to be the best wheat. Blue Stem was next, and Ladoga was very poor. It was apparent that any injury to the wheat reduces its value for milling and bread-making.

Twenty-five bushels of each of the following varieties of wheat were milled: Pure Scotch Fife; pure Blue Stem; pure Ladoga, and Scotch Fife threshed while wet, slightly bleached, badly frosted, and badly bleached. All the wheat tested was grown on average Red River Valley soil, near Hallock, Minnesota.

The Ladoga milled the most easily, the bran cleaned the best, and the middlings purified best and came out in the best form. Pure Scotch Fife came second as to mechanical loss of milling, and then the Fife [threshed while wet] and Blue Stem. The bleached wheats milled well but did not finish well. The frosted wheats milled badly, the bran was brittle, pulverized easily, and could not be cleaned up well; the middlings were correspondingly dark and hard to reduce and purify.

The weight of the wheat milled and returned is given in the following table:

Weight of wheat milled and returned.

Kind of sample.	Flour.			Offal.			Total.		Per cent. loss (−), gain (+).
	Patent.	Straight	Four X.	Bran.	Shorts.	Germ.	From mill.	Wheat run through.	
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	
Pure Scotch Fife	339.0	544.5	96.5	192.0	25.0	121.5	1,318.5	1,341.0	− 1.83
Pure Blue Stem	335.5	690.5	67.0	232.0	33.5	74.0	1,432.5	1,460.0	− 1 91
Pure Ladoga	290 5	504.0	62.0	210.0	26 0	77.5	1.170.0	1,249.0	− 6.35
Scotch Fife	321.0	626.5	15.0	263.0	138.0	88.5	1,452.0	1,457.5	− 1.39
Scotch Fife, slightly bleached	317.0	651.0	38.0	226.0	151.0	75.0	1,458.0	1,456.5	+ 0 10
Scotch Fife, slightly frosted	302.0	559.5	64.0	252.5	220.5	108.5	1.507.0	1,437.0	+ 4.87
Scotch Fife, badly frosted	198.0	507 0	131.0	234.0	36.0	139.5	1,245.5	1,434 0	−13.20
Scotch Fife, badly bleached	301.0	628.0	35.0	248.0	125.0	52.0	1,389.0	1,453.5	− 4.43

These results when expressed in percentages, taking as a basis the result of the largest amount of flour received in each case as 100, will stand in the following relation to each other for the flours:

Kind of wheat.	Patent.	Straight.	Four X.	Total.
Pure Scotch Fife	100.00	85.66	69.77	97.44
Pure Blue Stem	91 09	100.00	44.39	100.00
Pure Ladoga	96.58	89.38	50.38	95.96
Scotch Fife, threshed while wet	85.99	89.50	9.98	86.91
Scotch Fife, bleached	84.59	92.57	25.76	90.42
Scotch Fife, badly bleached	84 29	93.82	23.95	90 98
Scotch Fife, badly frosted	61.80	84.56	100.00	87.98
Scotch Fife, slightly frosted	77.94	77.24	40.49	80.51

As to the character of the flour, the pure Scotch Fife had the best feel and appearance, the Ladoga the worst, and the others range, after the Scotch Fife, in this order: Blue Stem, [threshed while wet], badly bleached, slightly bleached, and frosted. These last have a weak, sticky feel and a grayish cast. The bleached flours are weak and very white. The Ladoga has a very peculiar saffron color, quite different from anything else. * * * Bread was baked from each lot of flour, and of the patent and straight flours a great many loaves of each were baked at different times to secure reliable results on the following points: (1) The amount of flour necessary to make the best bread with a definite quantity of yeast liquid; (2) the "strength" of the flour as determined by the dimensions of the loaf made from a definite quantity

of flour and yeast mixture; (3) the absorptive and retentive capacity of the flour as determined by the weight of the bread made with a definite quantity of yeast mixture and flour; (4) the quality of the bread as determined by its color and texture. The results are as follows, on a standard of 100:

Results of baking tests of different kinds of wheat.

Kind of wheat.	Amount of flour required.	Dimensions of loaves	Absorptive and retentive capacity of flour.	Color and texture of bread.
Scotch Fife, badly bleached	95.52	95.89	92.31	99
Scotch Fife, slightly bleached	97.18	90.45	94.05	95
Scotch Fife, slightly frosted	92.84	96.77	92.09	93
Scotch Fife, badly frosted	94 74	95 85	92.21	91
Scotch Fife, threshed while wet	93.68	93.71	92.72	98
Pure Blue Stem	94.61	98.73	92.55	97
Pure Scotch Fife	93.46	92.74	99.27	100
Ladoga	98.62	88.16	93.82	50

The pure Scotch Fife bread was clearly the best in every case as to color, texture, and odor. It was a bright, rich creamy white. The badly bleached Fife came next, but was deficient in richness of appearance. The Fife [threshed while wet] was richer looking than the bleached, but a little dingy in color. Blue Stem was as rich looking as any and of good texture, and had a very slight bluish or greenish tinge. The slightly bleached wheat looked weak and rather dingy. The slightly frosted was grayish and the worst frosted noticeably more so. The Ladoga retained its saffron color, but intensified, and was of quite a disagreeable appearance.

Wheat, comparative tests with selected seed (*Minnesota Sta. Bul. No. 23, Sept., 1892, pp. 147-166*).—Pure seed of Scotch Fife wheat, the result of careful selection during a number of years, was furnished to the station by Mr. C. A. Pillsbury for distribution to farmers, prizes being offered by him for the best samples grown from this seed. The history of the wheat is given, and tabulated data on the 169 samples sent in from all parts of the State as the result of this test. The following summary is taken from the bulletin:

Reports tabulated	169
Injured by rust	11
Injured by frost	4
Reports on weight per bushel	119
Weight per bushel:	
64 pounds or over	16
63 pounds	26
62 pounds	24
61 pounds	23
60 pounds	9
59 pounds or less	11
Yield of grain per acre:	
40 bushels and over	6
35 to 40 bushels	10
30 to 35 bushels	19
25 to 30 bushels	17
20 to 25 bushels	27
17 to 20 bushels	13
Under 17 bushels	26

Days required for maturing:	
Maximum	118
Minimum	90
Average	106
Average yield per acre, bushels	24
Average weight per bushel, pounds	62

Experiments with field crops at New Mexico Station, A. E. BLOUNT (*New Mexico Sta. Bul. No. 6, Mar., 1892, pp. 19*).—Brief accounts of the first year's experiments with varieties of wheat, oats, rye, barley, buckwheat, corn, alfalfa, durra, millo maize, teosinte, lupines, lentils, cowpeas, vetches, broom corn, flax, hemp, jute, ramie, cotton, sorghum, and cultivated and native grasses. Most of these crops were successfully grown with a comparatively small amount of irrigation. Rye did especially well for winter and spring pasture. The dent varieties of corn, Mexican (native), Willis, Pride of the North, Piasa, and Prolific, were quite successful. The sweet varieties were destroyed by the corn worm and stalk borer. *Lathyrus sylvestris* failed to germinate. The soil and climate of this region are very favorable to the growth of broom corn. Of the varieties tested, Long Green and Dwarf gave the best results. The fiber plants did well, especially ramie. Teff grass (*Eragrostis abyssinica*) and crimson clover were the best of the grasses and clovers.

HORTICULTURE.

A. C. TRUE, *Editor*.

Tomatoes as a spring and summer greenhouse crop, E. C. GREEN (*Ohio Sta. Bul. No. 43, Sept., 1892, pp. 106–108*).—Practical directions for the management of this crop.

Tomatoes are advised as a spring and summer crop after lettuce can be no longer forced with profit. The essential points to be regarded are, (1) to have the plants sufficiently advanced to set in the beds about the middle of March or as soon as the last crop of lettuce is cleared off, (2) to prune off all the lower branches and suckers, (3) to keep the plants tied to supports. The varieties best adapted to the purpose are Acme, Beauty, and Perfection. Dwarf Champion is useful where the space under the glass is limited.

Lettuce as a greenhouse crop, W. S. TURNER (*Ohio Sta. Bul. No. 43, Sept., 1892, pp. 108–114*).—Practical directions for the management of this crop and a list of varieties of lettuce classified according to their habits of growth.

"Lettuce is the most profitable of all greenhouse crops. The first sowing should be made in September and at intervals of three or four weeks. The heaviest and most profitable crop comes off during February and March. The best variety for this latitude is Grand Rapids."

The apple trees and apple crop on the Iowa College farm, J. L. BUDD (*Iowa Sta. Bul. No. 18, Aug., 1892, pp. 517–522*).—Tabulated notes on observations during the season of 1892 on the crop and

foliage of apple trees in an orchard containing mainly Russian varieties. The extent to which scab and blight prevailed is also noted. The following summary is taken from the bulletin:

(1) The year 1892 is remarkable for scarcity of apples and general prevalence of scab and diseased foliage on west European apples, Siberian crabs, and native crabs. On the college grounds very few of these are exempt from scab, and those that are exempt show other leaf trouble.

(2) Russian apples have good foliage and are exempt from scab, although intermingled in the orchard with scabbed varieties. In many cases in Haas trees partly top-grafted with Russian varieties, the Haas part of the top is scabbed while the Russian part is exempt.

(3) The Russian varieties that did not bear very heavily last year have from a good to a very large crop this year, and many varieties that bore a heavy crop last year have an equally large crop this year.

Strawberries, test of varieties, M. H. BECKWITH (*Delaware Sta. Bul. No. 18, Sept., 1892, pp. 3–10*).—Tabulated and descriptive notes on 59 varieties. Among the varieties commended are Bubach No. 5, Eureka, Haverland, Parker Earle, Van Deman, and Woolverton.

Strawberries, test of varieties, C. A. KEFFER (*Missouri Sta. Bul. No. 18, Aug., 1892, pp. 8*).—Tabulated data for 119 varieties. The following were the "10 best varieties, all things considered, named in order of earliness: Michel Early, Crescent, M. A. C. No. 23, Greenville, Haverland, Shuster Gem, Miner Prolific, Ontario, Bubach No. 5, and Parker Earle."

Greenhouse experiments, W. J. GREEN (*Ohio Sta. Bul. No. 43, Sept., 1892, pp. 99–106*).

Synopsis.—Brief accounts of experiments with (1) overbench *vs.* underbench piping; (2) commercial fertilizers in addition to compost; (3) subirrigation; (4) the water bench, and (5) crops suitable for forcing in Ohio. The results indicate, (1) little difference between the effects of the two methods of piping; (2) no benefit from the use of commercial fertilizers; (3) beneficial effects from subirrigation for lettuce, radishes, and tomatoes; (4) advantages in the use of the water bench for the germination of small seeds and the watering of young transplanted plants; (5) the profitableness of forcing lettuce, radishes, mushrooms, tomatoes, and cucumbers.

Overbench vs. underbench piping.—Experiments in two greenhouses heated with hot water but piped differently, have shown little difference in the crops grown with overbench as compared with underbench piping. In the house piped overhead there was noticed a slight tendency of the plants to grow spindling. Mushrooms did better with the overbench piping. In the case of the other crops, lettuce, radishes, cucumbers, tomatoes, asparagus, and pieplant, the results were negative. Reference is made to experiments recorded in Bulletin No. 15 of the Massachusetts Hatch Station (E. S. R., vol. III, p. 289), which favored the underbench piping.

Experiments with fertilizers.—The application of cotton-seed meal, linseed meal, sulphate of ammonia, nitrate of soda, sulphate of potash, and superphosphate in various combinations, in connection with the

rich compost commonly used in greenhouses, did not produce any effect on lettuce, radishes, or tomatoes grown in a clay loam soil.

Subirrigation in the greenhouse.—A brief account of experiments begun in 1890 to test the effect of supplying greenhouse plants with water from below instead of watering them by the usual method.

The first trial was made in boxes 16 inches square; the second in a bed 7½ by 12 feet. The past winter two beds, one in each house, each 7½ by 15 feet, were fitted up for the purpose. The middle portion of the bed, 15 feet in length in each house, was floored with matched flooring laid in white lead so as to be water-tight. The ends and sides were also made water-tight. In the bottom of these beds or benches 3-inch tiles were laid 2½ feet apart and so arranged that water could be supplied to each row of tiles as desired. Six inches of soil was then placed on the benches, covering the tiles out of sight. * * *

Three crops of lettuce and one of tomatoes were grown in each of these beds. Radishes and lettuce were grown in the bed used the season previously, also in another bed, 4 by 8 feet, in which 1-inch iron pipes, with small holes drilled 1 foot apart, were employed instead of tiles. Records have been kept of the results, but as the experiment is not completed the details will no' be given until some time in the future. * * *

The effect of the treatment upon the lettuce rot was by no means decided, there being possibly a little difference in favor of subirrigated beds. The disease was not very troublesome in either case and further trial is necessary before anything can be affirmed on this point.

The effect of subirrigation upon the growth of both lettuce and radishes was remarkable, but on tomatoes the effect was less noticeable. The effect on cucumbers was decidedly beneficial. The first crop of lettuce the past winter on the subirrigated bed was about 30 per cent heavier than the crop on the bed treated in the ordinary manner. There was a still greater difference in the second crop, the gain being about 50 per cent in favor of subirrigation. Subirrigated radishes came to marketable size earlier and were larger than those grown by the ordinary method. The difference in earliness was more marked than the difference in total weight. Nearly one half the subirrigated radishes were marketed before any of the others were ready to pull. The effect was more marked in the long radishes than in the turnip-rooted sorts. * * *

The water bench.—This is simply a water-tight bench, so named to distinguish it from the soil bench, and may be constructed on the same plan as the benches used for subirrigation, except that the sides ought not to be more than 2 inches high. This bench may be of any dimensions desired and in any part of the house. * * *

Perhaps the best plan is to construct a water bench in a part of the house that is to be devoted to young plants, and immediately underneath the first bench put in another of the same dimensions. The second or lower bench is to be used for germinating seeds, and little or no light is required. It should be a foot or more below the bottom of the upper bench, so as to give room to pass flats in and out easily.

The use of these water benches is to water seed just sown and young plants recently transplanted, without the application of water to the surface of the soil. Seeds are sown in flats having about 2 inches depth of soil; these flats are then transferred to the water bench and watered by means of subirrigation, which is accomplished by letting into the water bench sufficient water to soak the soil in the flats quite thoroughly, but not enough to make it mortar-like or pasty. Small plants are transplanted into flats and treated in the same manner. * * * This method of watering is satisfactory and saves labor. Not only can the soil be thoroughly and evenly watered in this manner, but there is no danger of washing out seed nor of knocking over young plants. The method is especially applicable to small and delicate seeds.

Crops suitable for forcing.—Brief statements regarding the crops which are most profitable to force in greenhouses in Ohio under present conditions, and a monthly calendar of work in this line for the use of beginners in this industry. "The crops most suitable for forcing in this State are lettuce, radishes, mushrooms, tomatoes, and cucumbers."

WEEDS.

WALTER H. EVANS, *Editor.*

Wild or prickly lettuce (Lactuca scariola), a pestiferous weed, C. E. THORNE (*Ohio Sta. Bul. No. 44, Sept., 1892, pp. 141–146, plates 3*).—A popular description and account of this weed, with suggestions for its destruction. Mention is also made of a fungus (*Septoria similis*) occurring upon it in great abundance and spreading from this host to the cultivated lettuce. The fungus is figured in one of the plates.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

A preliminary list of the rusts of Ohio, F. DETMERS (*Ohio Sta. Bul. No. 44, Sept., 1892, pp. 133–140*).—Of the 69 species of *Uredineæ* mentioned as occurring in Ohio, the author reports 44, also their hosts and place and time of collection, together with occasional notes. Of this list, 7 are species of *Uromyces*, 18 of *Puccinia*, 13 of *Æcidium*, 2 of *Phragmidium*, and 1 each of *Gymnosporangium*, *Melampsora*, *Cæoma*, and *Coleosporium*. In the citation of authorities, departures from Farlow and Seymour are noticed in the following cases: *Uromyces polygoni* Pers. for (Pers.) Fckl.; *U. trifolii* Alb. and Schw. for (Hedw. f.) Lev.; *Puccinia maydis* Carradori for Berenger; *Phragmidium fragariæ* (D. C.) Rosm. for Wint.; *Melampsora populina* Wint. for (Jaq.) Lev.; *Æcidium grossulariæ* Schum. for D. C. In the case of several species no authorities are given.

Scab of wheat (Fusisporium [Fusarium Sacc.] culmorum), F. DETMERS (*Ohio Sta. Bul. No. 44, Sept., 1892, pp. 147–149, figs. 2*).—A description and brief account of this fungus. It was previously noticed in Bulletin No. 36 of the Indiana Station (E. S. R., vol. III, p. 512) and Annual Report of the Delaware Station for 1890 (E. S. R., vol. III, p. 689).

Some diseases of plants common to Iowa cereals, L. H. PAMMEL (*Iowa Sta. Bul. No. 18, Aug., 1892, pp. 488–505*).—In this paper the author mentions rust of wheat, blight of wheat, loose and stinking smut of wheat, rust and smut of oats, rust of barley, yellow leaf disease of barley, and rust and ergot of rye as the prevailing diseases of cereals in Iowa. The meteorological record for May, June, and July, 1892, is given, showing conditions very favorable to the development of plant

diseases. The rusts of wheat are treated at considerable length. The covered wheat rust (*Puccinia rubigo-vera*) is most abundant and destructive. During the last season the common rust (*P. graminis*) was also rather abundant. From a number of investigations the conclusion is reached that hard red wheats resist the attacks of rust better than other varieties. Wheat blight or wheat scab (*Fusarium culmorum*) has been rather troublesome. For smut of wheat the hot water treatment is advised. Two species of rust attacked oats, *Puccinia graminis* on stems, sheaths, and glumes, and *P. coronata* on leaves. A patch of oats treated for smut was badly infested with rust. The smut of oats is to be the subject of subsequent investigation. The diseases of rye and barley are not very destructive unless it be the yellow leaf disease of barley (*Helminthosporium graminum*), described in the Journal of Mycology, vol. VII, p. 96.

ENTOMOLOGY.

The strawberry weevil, M. H. BECKWITH (*Delaware Sta. Bul. No. 18, Sept., 1892, pp. 11–16, figs. 2*).—A compiled description of *Anthonomus musculus* and notes on observations by the author in 1892. Injuries by this insect were observed in strawberry beds in Delaware May 12–25, 1892. In breeding cages "the larvæ changed to pupæ within the infested blossoms and the perfect insect began to emerge from them on June 10. * * * The reared beetles soon began mating, and a number of them were transferred to breeding cages containing potted strawberry plants which were in bloom, but no eggs could be found either upon the plants or in the soil."

Notes on injurious insects, A. OSBORN and H. A. GOSSARD (*Iowa Sta. Bul. No. 18, Aug., 1892, pp. 506–516, fig. 1*).—Popular notes on the clay-colored bill bug (*Sphenophorus ochreus*), little brown bill bug (*Sphenophorus parvulus*), strawberry false worm (*Harpiphorus maculatus*), green strawberry slug (*Monstegia ignota*), and diamond-back turnip moth (*Plutella cruciferarum*), with suggestions regarding remedies. A successful experiment with London purple for the green strawberry slug is reported.

In ordinary seasons the worms have matured and entered the earth by the first of June, according to Mr. F. W. Malley, but insect life was unusually late in appearing this season and the worms were working their greatest injury from June 6 to 17. At the latter date hardly a leaf could be found in a small patch upon the experimental grounds that was not greatly eaten by them.

On June 9 this patch was thoroughly sprayed with London purple, 1 pound of powder to 200 gallons of water. Two and one half gallons of the mixture was applied to a patch containing very nearly 1 square rod. At this rate about 400 gallons of the mixture would be required per acre. Injury ceased within two or three days. That the insects were destroyed by the poison and did not merely enter the earth to pupate, seems proved by the fact that some larvæ caged in the same patch and from which the poison was excluded were feeding greedily for several days afterwards. Also an examination of the earth in the patch at this date, August 2, fails to discover any signs of larvæ that may have escaped.

Entomological notes, A. J. COOK (*Michigan Sta. Reports for 1890 and 1891, pp. 102–129 and 123–144, figs. 17 and 16*).—Experiments with kerosene emulsion for the destruction of the eggs of the currant sawfly (*Nematus ribesii*) were not successful. A 10 per cent emulsion destroyed the eggs, but was quite injurious to the foliage. Spraying with hellebore or Paris green after the eggs are hatched is considered more satisfactory.

The early brood of the cherry slug (*Selandria cerasi*) was unusually abundant and destructive in Michigan in 1890. Pulverized road dust, land plaster, carbolized plaster, or wood ashes, thoroughly applied to the leaves, destroyed the slugs. Solutions of pyrethrum, white arsenic, or London purple were ineffective. Whale oil soap (1 pound to 8 or 10 gallons of water) was successfully used. Strong kerosene emulsion will destroy the slugs, but great care must be taken to prevent injury to foliage.

Cutworms, especially *Hadena devastatrix* and *Agrotis subgothica*, were unusually abundant and destructive in Michigan in 1890. Experiments in the use of poisoned bunches of grass distributed in the field for the repression of cutworms were made in several places in Michigan with great success.

Agrotis c-nigrum in its different stages is described and illustrated. This species was reared by the author on the leaves of the currant. The zebra caterpillar (*Ceramica picta*) was also observed on currants. "Not only were the eggs laid on the currant leaves, but the insects fed freely and even matured on the currant foliage." The currant spanworm (*Eufitchia ribearia*) was observed for the first time in the vicinity of the station in 1890. A brief account is given of the American currant borer (*Psenocerus supernotatus*). *Hyperplatys maculatus*, observed as a currant borer at the station, is described and illustrated.

Observations by the author on the life history and habits of the parsnip seed moth (*Depressaria heracliana*) are reported, and the different stages of this insect are described and illustrated. Spraying with London purple has been found an effective means of repression.

Descriptive notes are given on the basswood spanworm (*Hibernia tiliaria*), which has been quite injurious to apple and elm trees in Michigan. "Spraying the trees with London purple as soon as the insects commence work is a sovereign remedy."

Brief accounts are given of a honeysuckle miner (*Lithocolletis trifasciella*), and of *Saperda concolor* and *Agrilus* spp. reared from galls on willows.

A list is given of the species of *Catocala* found in central Michigan, with the food plants of some of the species.

Tobacco decoction has been successfully used for two years in the repression of the cucumber flea beetle (*Crepidodera cucumeris*) and the striated flea beetle (*Phyllotreta vittata*). Experiments in 1889 confirmed those of previous years in showing the value of London purple and

Paris green as insecticides for the codling moth. London purple is preferred. Bordeaux mixture alone was of no value for this purpose. Details are given of unsuccessful experiments in spraying with the arsenites for the plum curculio, briefly reported in Bulletin No. 66 of the station (E. S. R., vol. II, p. 280). In 1891 evidence was collected showing that the insects are poisoned by the arsenites and that a certain percentage of the fruit is preserved by spraying.

Experiments are reported which indicate that the addition of lime to solutions of London purple will not prevent injury to the foliage of fruit trees unless the lime is thoroughly slaked. White arsenic solution used as soon as mixed did not injure peach foliage.

Experiments in the apiary in 1890 were much restricted owing to the fact that climatic conditions largely prevented the storage of honey. Contrary to a prevalent opinion, golden-rod furnished food for bees during several weeks in the autumn. Experiments indicate the desirability of "placing large boxes about the hives and packing between these and the hives with excelsior, leaves, shavings, or chaff" for the spring protection of bees. Bees furnished with a liberal supply of food in the spring did better than those provided with only a maintenance ration. The experience of the author leads him to recommend "extracting the honey before it is capped." Bee-escapes have been found to be useful in extracting honey. Experiments in feeding drones indicate that the drones are large eaters and confirm the previous conclusions of the author "that the workers feed the drones, as they doubtless do the queen and larvæ, the rich nitrogenous food which they previously digest in their true stomachs." A feeding experiment briefly reported seemed to indicate that candy for bees "should be made from very finely pulverized sugar, and also that pure sugar sirup is not as good for bees, in confinement at least, as pure honey or honey and sirup mixed." Bees fed pure sugar sirup or section honey did well through the winter, thus confirming the author's opinion "that bees need no albuminous food in winter if kept very quiet, as they will be in a proper cellar."

In 1891 the experiments in apiculture at this station were under the direction of the U. S. Department of Agriculture.

The 15-spotted lady beetle (*Anatis 15-punctata*), poplar leaf beetle (*Gonioctena pallida*), pear blight beetle (*Xyleborus pyri*), *Syrphus americanus*, *Bassus sycophanta*, wee flour beetle (*Tribolium ferrugineum*), grain weevils, lacewing bugs, apple bud moth (*Tmetocera ocellana*), *Microdus laticinctus*, rose leaf roller (*Cacœcia rosaceana*), *Glypta simplicipes*, peach twig moth (*Anarsia lineatella*), *Copidosoma variegatum*, and imported cabbage leaf miner are described, with illustrations.

Preliminary report on an insect injurious to wheat, O. LUGGER (*Minnesota Sta. Bul. No. 23, Sept., 1892, pp. 167–170*).—Descriptive notes on observations on an insect which injured wheat in the fall of 1892, in the Red River Valley, by partially breaking off the culms 3 or 4 inches

from the ground. The puparia found are described as "glossy chestnut brown, shading to a yellowish brown towards the smaller end; faint indications of sutures or segments are visible. All these seed-like objects contained at that time the larvæ or worms, which are of a white color. No pupæ could be detected during the investigation, nor can they be found at this date (September 28)." The author believes that the insect is a frit fly.

Scale insects in New Mexico, C. H. T. TOWNSEND (*New Mexico Sta. Bul. No. 7, June, 1892, pp. 23, plates 3*).—A bulletin of information for fruit growers, issued in view of the increasing necessity for vigilance to prevent the spread of the San José scale and kindred species in New Mexico. The classification and general habits of scale insects are given, with descriptive notes on the following species and accounts of their insect enemies: San José scale (*Aspidiotus perniciosus*), white pear scale (*A. rapax*), convex scale (*A. convexus*), chilopsis scale (*A.* n. sp.), locust scale (*Lecanium robiniæ* Riley), soft peach scale (*L.* sp.), larrea scale (*Signoretia* sp.?), Palmer's icerya (*Icerya palmeri*), and cottony mesquite scale (n. gen. et n. sp.). Formulas for insecticides for scale insects and directions for their use are also given.

The food of the robin,* E. V. WILCOX (*Ohio Sta. Bul. No. 43, Sept., 1892, pp. 115–131*).—This paper consists mainly of a discussion of the result of an examination of the stomach contents of one hundred and eighty-seven robins taken in Ohio during the months of April, May, June, July, and August. The majority of the birds were killed on the station grounds, but about fifty were taken in other parts of the State. Considerable space is given to synopses of work in the same line by other investigators, especially by S. A. Forbes in Illinois and F. H. King in Wisconsin. The animals and plants, or their fragments, were determined carefully (in most cases specifically) and the species were arranged in three categories, viz, beneficial to man, injurious to man, and neutral, *i. e.*, of no economic importance so far as known. An attempt was also made to determine the ratio of each element of the food to the entire stomach contents, and the results have been embodied in a carefully prepared table which shows "the percentage of each particular article of diet in the whole food for each month and the number of robins which were found to have eaten the particular food during the month." A partial summary is given for each of the five months and a general summary for the whole period.

It is estimated that insects formed 65½ per cent of all the food; other animals (Mollusca, Crustacea, earthworms, myriapods, and spiders) 3½ per cent; and the remaining 31 per cent consisted of vegetable matter, mainly fruits. About four fifths of this fruit was cultivated, and hence a loss to the grower. The ratio of beneficial insects to injurious ones is not given separately, but it is stated that the results indicate that

*Abstracted by W. B. Barrows.

the robin's food consists "on the average of 52 per cent of species, plants, and insects which are beneficial to us, about 19 per cent which are injurious, and 29 per cent whose economic relations are not known." This means in plain language that the birds whose stomachs were examined probably were doing nearly three times as much harm as good, and in view of this fact the author's suggestion "that the fruit grower should at least be allowed to kill the robin during the season when he is most harmful, and not, as at present, be in danger of arrest," must be regarded as very moderate.

It is unfortunate that no nestling robins were examined during these months, since it is highly probable that their food would have shown marked differences from that of the adults. The method used in determining the ratios of animal to vegetable food is also open to serious objections, and this alone may have vitiated the results in many cases. The omission of details of the record, owing to lack of space, may account for its apparent incompleteness.

The fact originally demonstrated by S. A. Forbes, that robins consumed a very large number of predaceous beetles, is verified in the present paper, since 14 per cent of the entire stomach contents consisted of *Carabidæ*.

Mr. Wilcox's paper is followed by remarks by the horticulturist of the station, and Mr. F. M. Webster records the result of his observations on crane flies as food of the robin. His investigations did not warrant the belief that much help could be expected from the robin in restricting this pest of grass and wheat lands.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

A contribution to the economies of milk production, C. F. VANDERFORD (*Tennessee Sta. Bul., vol.* V, *No. 3, July, 1892, pp. 121–130*).—A feeding trial is described with sixteen cows, including Jerseys, Holsteins, and grades, which were divided as nearly as possible into two lots. During the first period, from November 26 to December 30,—thirty-five days—lot A received a daily ration per 1,000 pounds live weight of 30 pounds of silage from sorghum and pea vines, 5.22 pounds of mixed hay, 3 pounds of cotton-seed meal, and 5 pounds of wheat bran; and lot B 30 pounds of silage, 5.12 pounds of hay, and 10 pounds of a mixture of equal weights of corn and oats ground together. Valuing the silage at $2, the hay at $8, the cotton-seed meal at $24, the wheat bran at $20, and the corn and oats mixture at $18 per ton, the daily ration per 1,000 pounds live weight cost 13.69 cents for lot A and 14.5 cents for lot B.

During the second period, from December 31 to February 3,—thirty-five days—the lots were reversed, lot A receiving practically the same ration as lot B had received, and *vice versa*, except that corn silage was used instead of pea vine and sorghum silage. The percentage of fat in the milk was tested at intervals by the Babcock test. The nutritive ratio for lot A was 1:4.7 in the first period and 1:9.7 in the second period, and for lot B 1:8.9 in the first period and 1:4.5 in the second period. Data with reference to the yield of milk, percentage of butter fat in the milk, cost of food consumed, and fluctuations in live weight, and the analysis of silage from corn and from pea-vines and sorghum, and of cotton-seed meal are tabulated. The average results of the trial were as follows:

Average results per period.

	Nutritive ratio.	Yield of milk per day.	Percentage of fat in milk.	Cost of food—	
				Per gallon of milk.	Per pound of butter fat.
Lot A:		*Pounds.*	*Per cent.*	*Cents.*	*Cents.*
First period	1:4.7	146.13	4.82	5.41	13.10
Second period	1:9.7	129.47	4.47	6.58	17.16
Lot B:					
First period	1:8.9	152.19	3.96	5.39	15.88
Second period	1:4.5	132.79	4.26	5.96	16.28

A few practical conclusions may be fairly stated:

Dairying in Tennessee, whether for milk production or for butter-making, can be made highly profitable under good management.

For winter dairying the silo is indispensable.

It pays to purchase, at ordinary market prices, such feeding stuffs as cotton-seed meal and wheat bran, not only to increase the product of the dairy, but as a means of maintaining, and, when butter alone is sold, of increasing the fertility of the farm.

It will always pay the dairyman to weigh and to test carefully the product of each cow of his herd, so that he may know how and whence his profits or his losses come.

Experiments with sheep, J. WILSON and C. F. CURTISS (*Iowa Sta. Bul. No. 18, Aug., 1892, pp. 459–469*).—In an experiment in wintering breeding ewes, four Merinos, four Cotswolds, four Dorsets, four Oxfords, three Hampshires, three Shropshires, and three Southdowns were used, each breed being kept in a pen by itself. The trial lasted from December 10 to March 7—ninety days. The food consisted of clover and timothy hay and a mixed grain ration composed of oats, corn, bran, and linseed meal. These were fed in sufficient quantities to maintain the flock in good condition without much increase in live weight. Several of the ewes dropped lambs during the trial. For the first fifty-three days, during which no lambs were dropped, the amount and cost of the food eaten, gain in live weight, etc., are tabulated. During this time "the daily cost of feed per sheep in each breed was, for Merinos

1.03 cents, Cotswolds 1.35 cents, Dorsets 1.21 cents, Oxfords 1.32 cents, Hampshires 1.26 cents, Shropshires 0.97 cent, and Southdowns 0.60 cent. * * * The foregoing figures fairly represent the relative cost of wintering breeding ewes of these breeds under conditions given in this experiment."

The ewes were all sheared between April 13 and 16. The yield of wool by each sheep, the average for each breed, the percentage of shrinkage in scouring, value of the fleece, and the results of microscopic measurements are tabulated. The wool was classified and valued by wool experts. The average value of unscoured wool per head was in the following order: Cotswold, Oxford, Merino, Shropshire, Hampshire, Dorset, and Southdown.

Corn vs. barley for pigs, C. D. SMITH (*Minnesota Sta. Bul. No. 22, Aug., 1892, pp. 117–126*).

Synopsis.—A comparison of corn meal with barley meal, each fed alone or in combination with shorts or shorts and linseed meal. Six lots of five to six pigs each were fed during fifteen weeks. As a result the lot on barley meal alone made a much larger gain than the lot on corn meal alone, but in all other cases the lots fed on mixtures containing corn meal made a larger total gain than those on barley meal, and the gain in live weight per 100 pounds of food was practically the same with both kinds of food.

The object of this experiment was to compare corn meal with barley meal for pigs when fed alone and when each was combined with shorts and oil meal. Thirty-four pigs were divided into six lots as nearly equal as possible, two lots containing five pigs each and the remaining four lots six pigs each. The average weight of the pigs was 42 pounds. These lots were fed from July 21 to November 4, as follows:

Lot 9..............corn meal.
Lot 10..............barley meal alone.
Lot 11..............corn meal and shorts equal parts by weight.
Lot 12..............barley meal and shorts equal parts.
Lot 13..............corn meal and shorts two parts each and oil meal one part.
Lot 14..............barley meal and shorts two parts each and oil meal one part.

The feed was mixed with sufficient water to make a thick slop. All the pigs were allowed all the charcoal, ashes, and salt they would eat. Each pig was weighed weekly during the progress of the experiment. The feeding trial was prefaced by a preliminary period of one week and the remainder of the time was divided into three equal periods. The amount of food consumed by each lot was recorded for each week. The live weight at the end of the trial ranged from 86.7 to 169 pounds

per pig. The results are tabulated by periods and are summarized in the statement below:

Food consumed and weight gained by pigs.

	Rations.	First period.			Second period.			Third period.			Average total gain per pig during trial.
		Average gain per pig.	Food eaten per pig.	Gain per 100 pounds of food.	Average gain per pig.	Food eaten per pig.	Gain per 100 pounds of food	Average gain per pig.	Food eaten per pig.	Gain per 100 pounds of food.	
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*
Lot 9	Corn meal alone	18.4	513.5	17.9	14.4	538	15.2	10.2	328.5	12.4	43 0
Lot 10	Barley meal alone	23.8	554.0	21.4	37.2	872	21.3	20.5	525.5	15.6	81.5
Lot 11	Corn meal and shorts	33.7	811.5	24 9	41.1	1,131	21.8	31.0	893.0	17.4	105.8
Lot 12	Barley meal and shorts	33.3	762.0	26.2	40.5	1,062	22.8	24.0	821.5	14.6	97.8
Lot 13	Corn meal, shorts, and oil meal	34.8	771.0	27.1	40.0	1,158	20.7	29.8	924.5	16.1	104.6
Lot 14	Barley meal, shorts, and oil meal	34.0	728.0	28.0	38.0	1,080	22.0	20.2	853.0	11.9	92.2

It will be seen that of the two lots fed corn meal and barley meal alone, respectively, lot 10, receiving barley meal, made much the larger total gain in live weight and the larger gains per 100 pounds of food. In each of the other two comparisons of corn meal and barley meal (lots 11 and 12 and lots 13 and 14), the lots receiving corn meal made the largest total gains in live weight, but the average gain of weight per 100 pounds of food during the whole trial was practically the same for the corn-meal as for the barley-meal lots. The author's summary of the results is as follows:

(1) When fed as the entire ration of pigs, 100 pounds of barley meal was found to produce as great a gain as 119.5 pounds of corn meal.

(2) When mixed with shorts in equal parts, 100 pounds of barley meal and shorts produced as great a gain as 105.2 pounds of corn meal and shorts.

(3) When to the mixtures with shorts one fifth part of oil meal was added, then 100 pounds of barley meal, shorts, and oil meal produced as great a gain as 103.3 pounds of corn meal, shorts, and oil meal.

(4) The older the pig grows the more food it takes to produce a pound of gain.

(5) In this experiment the addition of oil meal to the ration of either barley meal and shorts or corn meal and shorts, after the pig had attained an average weight of slightly over 100 pounds, was deleterious.

(6) The continued use of corn meal as the sole food of growing pigs was found to be productive of too great a tendency to become excessively fat without a normal growth of bone and muscle, and to produce unhealthy pigs, while the use of barley alone was not attended with this result.

(7) The pigs throughout the experiment consumed more corn meal and shorts than barley meal and shorts, and produced a greater gain with the former than the latter, but, except in the third period, at a greater expense of food consumption.

(8) The same relation holds good where oil meal forms a fifth part of the ration.

(9) When fed to pigs weighing 125 pounds or more, 100 pounds of corn meal and shorts produced as great a gain as 119.1 pounds of barley meal and shorts.

(10) When fed to pigs weighing 125 pounds or more, 100 pounds of corn meal, shorts, and oil meal, mixed as indicated, produced as great a gain as 135.2 pounds of barley meal, shorts, and oil meal.

Corn vs. barley for fattening hogs, W. M. HAYS (*Minnesota Sta. Bul. No. 22, Aug., 1892, pp. 127, 128*).—Two lots of hogs which had been at pasture during the summer, each containing five hogs ranging in weight from 160 to about 300 pounds, were fed from October 6 to November 26. Lot 1 received corn meal and lot 2 barley meal. The barley meal fed at first was not relished by the hogs and it was exchanged for a better quality. The gains in live weight are tabulated for each lot. During the period of fifty-one days lot 1 gained 1 pound in live weight for each 5 pounds of grain eaten, or 11.2 pounds of gain per bushel of corn, and lot 2 gained 1 pound for each 7½ pounds of barley meal eaten. During the time that good barley was fed the lot receiving it averaged 1 pound of gain per 5.9 pounds of food.

"The comparison of corn and good barley was hardly fair at any time. The fact that good, bright malting barley is of more feeding value than that considerably 'off' color and flavor is certainly here illustrated."

Corn meal, barley meal, and a mixture of nine tenths barley meal and one tenth oil meal compared, W. M. HAYS (*Minnesota Sta. Bul. No. 22, Aug., 1892, pp. 129, 130*).—The pigs in lots A and C were fed corn meal, those in lots B and D were fed barley meal, and those in lot E were fed a mixture of 0.9 barley meal and 0.1 linseed meal. The pigs were all over a year old, but their weights at the beginning of the trial are not given. The separate lots contained from three to four pigs each. The results with barley meal and corn meal were conflicting, as is shown by the following:

"With pens A and B considerably less corn than barley was consumed to make a pound of pork, while in pens C and D the result is reversed. The addition of one tenth of oil meal to the barley given in pen E made only a slight decrease in the pounds of grain needed to make a pound of gain."

Wet vs. dry feed for pigs, C. D. SMITH (*Minnesota Sta. Bul. No. 22, Aug., 1892, pp. 131–136*).

Synopsis.—A comparison of feeding a mixture of two parts of corn meal, two parts of shorts, and one part of linseed meal, dry and mixed with water to a thick slop, on four lots of three pigs each, indicated that in this case the mixing with water was advantageous. Two lots receiving charcoal showed a distinct benefit from the charcoal.

Twelve pigs, averaging 20½ pounds each, were divided into four groups of three each and fed from August 1 to November 28, including a preliminary period of one week, a mixture of two parts by weight of corn meal, two parts of shorts, and one part of old-process linseed meal. The food for lots 1 and 4 was mixed with water to a thick slop, and that for lots 2 and 3 fed dry. In addition to this, lots 1 and 2 received

charcoal. The gains made by the individuals in each lot were quite irregular, but—

> Judging from the behavior of the pigs in these four pens it may be safe to conclude that for the ordinary farmer who desires his pigs to grow as rapidly as possible it is an advantage to feed the food wet rather than dry. * * *
>
> The two pens receiving charcoal taken together made a gain greater by 70.5 pounds than the pens receiving none, and consumed but 211.5 pounds more feed, showing a distinct benefit from the use of the charcoal.
>
> A point of importance as to its bearing on the experiment as a whole is the difference in gain made by the individual pigs in each pen. While fed and treated in every way the same, the six red pigs [cross of Duroc-Jersey and Berkshire] gained 619.5 pounds and the six black ones [cross of Duroc-Yorkshire and Essex] 487 pounds, a difference of 132.5 pounds, or more than one third of the entire gain of the black pigs. Unfortunately the amount eaten by each pig was not separately kept and we can only presume that the red pigs ate proportionately more feed than the black ones. However this may be, it is evident that the profit in swine-feeding depends largely upon the quality of the hogs selected to feed. Individuality, too, plays an important part in all feeding experiments.

Feeding colts, J. WILSON and C. F. CURTISS (*Iowa Sta. Bul. No. 18, Aug., 1892, pp. 470–477*).

Synopsis.—A comparison of whole grain with ground grain for colts. Two lots of three colts each were fed the whole and ground grain, respectively, for seventy-nine days. The lot on ground feed gained 472 pounds, and the lot on whole feed 431 pounds.

Six imported weanling fillies, comprising two Percherons, two English Shires, and two French Coaches, were fed together in one lot from October to March 1, preparatory to dividing into lots. They received a moderate grain ration, coarse fodder, and about 5 pounds each of whole milk, which was substituted at the end of three months by separator skim milk. March 1 the colts were divided into two lots, containing one each of the three breeds. Since January 1 those in lot 1 had gained 245 pounds and those in lot 2 241 pounds, the two lots being nearly equal in this respect. From March 1 to May 18—seventy-nine days—both lots received the same grain ration, composed of oats, shelled corn, barley, bran, and linseed meal; but to lot 1 this was fed ground and mixed with a small amount of moistened cut hay, while to lot 2 it was fed unground, dry, and without hay. Both lots received like amounts of hay and stover. Up to March 4 all had separator skim milk; it was then discontinued and the amount of grain slightly increased. The colts were kept in box stalls during the night and turned into a yard during the day. Salt was within their reach. All were in good health and thrifty. The food eaten and gains made are given for each animal. The weights at beginning and end of each month were taken on three successive days and averaged. Lot 1, ground feed, gained 472 pounds, and lot 2, whole feed, gained 431 pounds during the seventy-nine days—a difference of 41 pounds in favor of the lot receiving ground feed. "The results of utilizing separator milk for feeding colts may be regarded as highly satisfactory."

DAIRYING.

E. W. ALLEN, *Editor*

A farm creaming experiment, F. A. LEIGHTON and H. C. WALLACE (*Iowa Sta. Bul. No. 18, Aug., 1892, pp. 523–525*).—This experiment was made to determine whether when milk is paid for at a creamery on the basis of its fat content, any injustice would result from setting the evening's milk, skimming it in the morning, mixing the cream with the morning's milk and sending the mixture to the creamery instead of sending the whole milk of both morning and evening. This practice was followed in six separate trials, setting the evening's milk in Cooley cans in ice water. The milk was tested by means of composite samples. The conclusion was that "the creamery man would lose nothing if the cream and morning milk were delivered instead of the milk of both evening and morning, and the patron's loss would be only the amount of fat he left in the skim milk, which would of course depend on the efficiency of creaming."

Sweet vs. sour-cream butter, G. E. PATRICK, F. A. LEIGHTON, and D. B. BISBEE (*Iowa Sta. Bul. No. 18, Aug., 1892, pp. 478–487*).

Synopsis.—In nine comparative trials of making butter from sweet and from sour cream, the sour cream averaged about 3 per cent more butter than sweet cream and churned quicker, the butter from it was of better color, contained less fat and more water and casein, but did not keep as well in the five months' test as that from sweet cream. The loss of fat in churning and working the sweet cream was about 50 per cent greater than with sour cream.

This is a comparison of the sweet-cream and sour-cream methods of butter-making with reference to relative loss of butter fat, amounts of butter produced, amounts of casein in the butter, and keeping qualities of the butter. The work was done between January 13 and April 8, 1892.

Nine different experiments or comparative trials were made, all conducted on the same general plan, which was as follows: A quantity of sweet cream, fresh from the (Alpha) separator, was thoroughly mixed and then accurately divided by weight into two equal parts; one of these parts was churned immediately (or in some cases after keeping cool and sweet over night with ice—about sixteen hours); the other was ripened at 60° F. for twenty-four to forty-eight hours and then churned. The buttermilk was tested for fat by the Babcock test, and in a few cases the wash water and drippings from the working table were also tested. The butter was regularly analyzed at the laboratory, and in one case, as a check on the other work, the cream also was analyzed.

In each trial the two kinds of butter received the same amount of salt and the same amount of color.

Four 10-pound tubs of the butter produced, two of each kind, were held in cool storage at about 50° F. in order to compare keeping quality.

The results of these experiments are fully tabulated, and are summarized as follows:

(1) The yield of butter from sour cream was usually larger than from sweet; in nine trials it averaged 3 per cent larger.

(2) Sour cream usually churned quicker than sweet.

(3) The butter from sour cream usually contained less fat and more water than did that from sweet cream. In four trials the average difference in fat was nearly 2 per cent.

(4) The butter from sour cream usually contained a trifle more casein than did that from sweet cream. This was the case in eight of the nine trials made. The average difference was 0.2 per cent.

(5) The losses of fat in churning, washing, and working were less with sour than with sweet cream. In nine trials the average difference was nearly one half pound of fat per 100 pounds of butter made. This difference was sufficient to make the loss about 50 per cent greater in churning sweet than in churning sour cream.

(6) The sweet cream butter suffered less deterioration by keeping five months (at a temperature of about 50°) than did the sour-cream product. The former acquired in a measure the flavor and aroma of ripened-cream butter. These results fully confirm those obtained by one of us in 1890 in an experiment made jointly by the station and Mr. J. M. Daniels, of Dayton, Iowa [see Bulletin No. 11, E. S. R., vol. II, p. 330].

(7) Sweet cream butter did not "take" the color (oil color, Fargo's) as well as did that from sour cream; it was always some shades lighter in color.

Iowa State Agricultural College creamery, D. A. KENT (*Iowa Sta. Bul. No. 18, Aug., 1892, pp. 526–530, plates 2*).—This is an illustrated description, with plan of the State butter and cheese factory.

The building and all its appurtenances, including apparatus and machinery, has cost $17,000. It has capacity to manufacture 40,000 pounds of milk per day, affords facilities for the instruction of one hundred students in all practical details of making butter and cheese and for a thorough study of the principles which govern these operations. The commercial success of the plant is well illustrated by the fact that we are already receiving daily from 16,000 to 17,000 pounds of milk. We teach how to make butter and cheese by making them. The dormitories accommodate fifty students.

Experiments in the manufacture of cheese during June, L. L. VAN SLYKE (*New York State Sta. Bul. No. 45, n. ser., Aug., 1892, pp. 149–184*).

Synopsis.—A report of eighteen experiments in cheese-making during June, carried on at the station and at a cheese factory. The main results as far as they differ from those of the May experiments are summarized below.

As explained in Bulletin No. 43 of the station (E. R. S., vol. IV, p. 365), the station is engaged in a series of experiments in the manufacture of cheese at the station and at cheese factories, and proposes to publish the results monthly. In the present bulletin the results of eighteen experiments in June, nine at the station and nine at a cheese factory, are tabulated and discussed in much the same way as those for May, reported in Bulletin No. 43. "In addition to the variation of conditions of manufacture made in May, we have studied in two experiments the effect of using a temperature considerably above 98° F. for heating or 'cooking' the curd. Also in two other experiments a comparison was made between normal milk and the same milk partially skimmed."

The data include analyses of the milk, green cheese, and whey. The

results for June, in so far as they differ materially from those already reported for May, are given in the following summary:

Loss of milk constituents in cheese-making.—The actual amount of fat lost in the whey for 100 pounds of milk was fairly uniform under the same conditions of manufacture and was practically independent of the amount of fat in the milk.

The average amount of fat lost in the whey, in all the experiments, was 0.27 pound (a little over 4 ounces) for 100 pounds of milk, which was about 7.3 per cent of fat in the milk. In the factory experiments the average loss was about 7.5 per cent of the fat in the milk; in the station experiments it was about 7 per cent of the fat in the milk.

The amount of casein and albumen lost in the whey was quite uniform under all the conditions tried.

The average amount of casein and albumen lost in the whey in all the June experiments was about 0.78 pound (about 12½ ounces) for 100 pounds of milk, which was about 24 per cent of the casein and albumen in the milk. The loss was practically the same in both the factory and the station experiments.

Taking all the milks, the casein averaged 2.46 pounds and the albumen 0.76 pound in 100 pounds of milk; for every pound of albumen there were 3.3 pounds of casein.

Influence of composition of milk on composition of cheese.—In general the fat exercised a greater influence upon the composition of the cheese than did any other constituent of the milk. * * * The results appear to indicate that in cheese made from normal milk containing from 3.5 to 4 pounds of fat in 100 pounds of milk, there should be about 1.3 to 1.5 pounds of fat to 1 pound of casein and albumen in the water-free cheese. Partial skimming reduced this ratio to 1.21 and 1.14 pounds, while addition of cream raised it to 1.58 pounds.

Influence of composition of milk on yield of cheese.—Of the increased yield of cheese obtained in the various experiments, nearly three fourths of the increase on an average was due to an increase of fat in the milk from which the cheese was made. * * *

On an average the increase of casein and albumen in the milk produced about one sixteenth of the increased yield of cheese observed in the various experiments. * * *

About one fifth of the increased yield of cheese was due to an increased amount of water retained in the cheese.

Yield of cheese.—Of the factory milk there was required on an average 10.1 pounds to make 1 pound of cheese.

Of the station milk, 9.76 pounds sufficed to make 1 pound of cheese.

One hundred pounds of factory milk made on an average 9.9 pounds of green cheese; 100 pounds of station milk made 10.27 pounds of green cheese.

Influence of variation of conditions of manufacture.—The comparison [of amounts of rennet extract ranging from 2 to 4 ounces per 1,000 pounds of milk] gave results that were not definite in respect to loss of constituents or yield of cheese.

In one case hard cutting gave greater loss of fat, while in the other the soft cutting gave larger loss. The difference was small in either case.

The results regarding yield were not definite, the soft cutting giving more in one case and less in the other than the hard cutting.

The loss was practically the same in both processes [Cheddar and stirred curd].

In one case the Cheddar process gave a greater yield and in the other a smaller yield than the stirred-curd process.

The use of a temperature of 106° F. caused in two comparisons a noticeably greater loss of fat.

The higher temperature gave in both cases a smaller yield than did the use of the ordinary temperature.

Loss in weight of cheese during first month.—The loss of weight varied for the first month from 7.25 to 8.38 pounds, and averaged 7.77 pounds for each 100 pounds of green cheese.

STATION STATISTICS.

Third and Fourth Annual Reports of Michigan Station (*Michigan Sta. Annual Reports for 1890 and 1891, pp. 73-365 and 61-312, figs. 55 and 34*).—These reports, which are for the fiscal years ending June 30, 1890 and 1891, are published as parts of the Twenty-Ninth and Thirtieth Annual Reports of the State Board of Agriculture. The station reports include brief general accounts of its work in different departments and a financial statement, together with reprints of Bulletins Nos. 56-82, abstracts of which may be found in volumes II and III of the Record.

Annual Report of Virginia Station, 1891 (*Virginia Sta. Report for 1891, pp. 14*).—This is for the fiscal year ending June 30, 1891, and includes brief general reports by the director, treasurer, horticulturist, entomologist and mycologist, biologist, agriculturist, chemist, and veterinarian. During the year covered by the report the station force was reorganized, and it is the intention of the present management to confine the work of the station largely to two or three lines of investigation. Studies on tobacco will be made with reference to its varieties and botanical relationships, chemical composition, culture, manuring, curing, insect enemies, and diseases.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Monthly Weather Review (*Weather Bureau, Monthly Weather Review, vol.* XX, *Nos. 2-8, Feb.-Aug., 1892, pp. 33-234, charts 36*).—Besides the usual reports in this publication, the February number contains articles on the mean height and velocities of the different cloud forms, by H. H. Clayton, and on the wind direction at different altitudes around West India cyclones, by H. B. Boyer; the March number, an article on the average hourly precipitation at Washington, D. C., and New York; the April number, a report on the average hourly precipitation at selected stations; the May number, an article on the thunderstorms of May 3, 1892, in New York State, by E. T. Turner; and the August number, an article on the warm waves of July and August, 1892, by E. B. Garriott.

Report of the statistician (*Division of Statistics, Report No. 99, n. ser., Sept. and Oct., 1892, pp. 331-376*).—This includes the following articles: Farm prices in two centuries, report of ramie machine trials in New Orleans, Indian wheat crop of 1892, notes on domestic and foreign trade and industry, European crop report for September, and freight rates of transportation companies.

Farm prices in two centuries (pp. 332-346).—Extracts from an account kept by father and son in Connecticut and Pennsylvania from 1770 to 1842, inclusive.

An examination of these prices suggests the great advance in the rate of wages of labor and the still greater reduction in the cost of manufactures of all kinds. * * * The price of farm products was usually low, but fluctuated greatly according to local scarcity, which could not be mitigated by distribution from regions of plenty. If there were big crops they could not be sold; if relative failures, there was almost nothing to sell. Every locality, in its industries and products, existed for and by itself, having no relations with other communities; therefore the individual farm surplus was small, the inducement to produce wanting, and the ability to purchase other than farm supplies extremely limited. The industrious family had abundance of everything it could grow, such clothing as the loom of the household could produce, and such furniture as could be made on the place or in the neighborhood, and little else. And yet the man of industry and enterprise always laid aside some savings of the year, and grew relatively rich with what in the present day, with new wants and enlarged aspirations, would not suffice to make a moderate competency.

Ramie machine trials at New Orleans (pp. 347-354).—An account of tests of three machines, conducted under direction of this Department, September 30, 1892.

Three machines were entered for trial as follows: The Kauffman machine by the Kauffman Fiber Company, of New Orleans, Louisiana; the Felix Fremerey Decortica-

tor, by the Felix Fremerey Decorticator Company, of Galveston, Texas; the Fiber Delignating Machine (known as the J. J. Green machine) of the United States Fiber Company, of Versailles, Kentucky.

[The ramie used in these trials was grown at La Fayette, Louisiana. The jute was grown at the Sugar Experiment Station at Audubon Park, New Orleans.]

The following tabular statement of the results of the trials, with explanatory notes, is presented:

Green stripped ramie.

No. of test.	Machine.	Stalks.	Time of test.	Wet ribbons.	No. of men.
		Pounds.	*Hrs. min.*	*Pounds.*	
First	Kauffman	332	42 *a*	88*b*	3
Second	J. J. Green	225	1 35*c*	57½*d*	5

Jute leaves.

Third	Fremerey	100	31*e*	37¾*f*	4
Fourth	Kauffman	100	20	32*g*	5

a This covers the time between starting the machine and the moment when it became clogged and stopped. The upper waste apron gave trouble almost at the beginning of the test and stopped in fourteen minutes, after which the waste carried by this apron was removed by hand. The ribbon delivery apron clogged and stopped in forty-two minutes. After forty six minutes spent in overhauling the machine, the operator made an effort to proceed, when it was found that one of the eccentrics was heated and cut; the upper apron still refused to work, and the test was abandoned.

b Wet ribbons badly tangled and broken and showing a large percentage of woody waste. The hurds contained a small percentage of waste fiber.

c In this time there were three stops, aggregating sixty-seven minutes, to clean and readjust the working parts of the machine, the knife failing to split the stalks; after the last stop the test was abandoned.

d The machine gave a smoothly delignated ribbon, with small percentage of woody waste, save in a few stalks, in each instance, just before the machine became clogged.

e There were two stops, aggregating eighteen minutes, to readjust the machine.

f Smooth ribbons, practically free from woody waste.

g Ribbons well delignated, with very small percentage of woody waste. The fiber is occasionally somewhat broken.

One point demonstrated beyond all doubt at the recent trials, is the perishable nature of green ramie, either stripped of its leaves or unstripped, and the experience recorded emphasizes the importance of taking the machine into the field, where decortication in the green state is carried on. * * *

It is an interesting point for future experiment to determine whether ramie stalks can be perfectly dried in best condition for machine working in Louisiana, owing to the greater humidity of this section compared with other sections of the country suitable to ramie culture.

It would seem from my observations in Louisiana that slight kiln-drying will be necessary, after at least ten days of sun-drying in the field, in order that the stalks may be made sufficiently brittle for the machines to separate the woody matter readily.

Indian wheat crop of 1892 (pp. 355–359).

The final report of the Indian Government on the wheat crop of 1892 was issued on July 11, a month later than last year. It places the crop at 5,442,000 tons, or 203,168,000 bushels of 60 pounds. This marks it as the smallest crop harvested in any year since annual estimates were inaugurated in 1884. In the final report of last year the crop of 1891 was stated at 6,842,000 tons, or 255,434,667 bushels, but the pres-

ent return changes the estimate for 1891 to 6,876,000 tons, or 256,704,000 bushels. On the basis or this revised estimate the crop of the present year shows a falling off from that of 1891 of 53,536,000 bushels, or 21 per cent.

The area is returned at 24,088,000 acres against the revised estimate of 26,576,000 acres harvested in 1891. The normal or average area under wheat is placed at 26,544,000 acres, showing a falling off of acreage in 1892 from the average of 2,456,000 acres. These figures indicate a yield per acre of 8.4 bushels for 1892 against 9.8 bushels last year, and an average, calculated from the normal area and out-turn as given, of 9.5 bushels.

Domestic and foreign trade and industry (pp. 360-363).—Notes on the foreign trade of the United Kingdom, importation of corn into Mexico, tobacco-growing in Texas, and the cottage industries of Russia.

Condition of crops (*Division of Statistics, Report, Oct., 1892, pp. 23*).—The final report for the season on the condition of corn, potatoes, buckwheat, tobacco, and sugar cane, and the rate of yield per acre of wheat, oats, rye, and barley.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Influence of electric light on the structure of trees and herbaceous plants, G. Bonnier (*Compt. rend., 115 (1892), pp. 447–450 and 475–478*).—Experiments briefly reported in these articles were conducted by the author in the laboratory of physiological botany established by him at the *Halle Centrale* at Paris. The plants were grown under glass, with substantially constant conditions of temperature and moisture. The electric light was produced by an arc lamp, which in part of the experiments was covered with a glass globe to cut off the ultra-violet rays. In some cases the plants were exposed to the electric light day and night; in other cases, from 6 a. m. to 6 p. m.

The young tree plants experimented with included pines, beeches, oaks, and birches. Under continuous electric light the shoots of these plants were very green and their leaves were less crowded, less firm in structure, and longer than those of plants grown under ordinary conditions. The shoots were rich in chlorophyll and assimilated intensely, but showed less of differentiation in their tissues than normal shoots. Certain striking modifications in the anatomical structure of leaves and stems were observed. The tissues were not only retarded in their formation, but had an unusual structure. Respiration, assimilation, and transpiration went on day and night in an invariable way. When the electric light was intermitted during twelve hours out of the twenty-four its effects were much less striking, and the structure of the plants was more nearly normal.

The experiments with herbaceous plants were continued during seven months. A great variety of plants was used, among which were tulips, cereals, potatoes, flax, and numerous wild species, including *Ranunculus*, *Hieracium*, *Taraxacum*, etc. The plants were placed at a distance of from 1½ to 4 meters from an arc lamp. The electric light under glass caused active assimilation; for example, leaves of *Ranunculus bulbosus*, weighing 12 grams, placed in 400 c. c. of air containing 6 per cent of carbonic acid, at a distance of 2 meters from the lamp during one hour at a temperature of 13° C., evolved 1.05 per cent of oxygen, while the same leaves under similar conditions in diffused sunlight evolved 0.52 per cent and in direct sunlight 3.95 per cent.

As observed in experiments at the New York Cornell Station (Bulletin No. 30, E. S. R., vol. III, p. 232) and elsewhere, some plants languished even under discontinuous electric light. This was especially the case when plants were exposed to the naked light. On the other

hand, when exposed to the continuous electric light under glass, some plants showed for a time an exuberant growth, with very green leaves and flowers of deep color. The modifications were similar to those which take place in plants grown in high latitudes. Under an intense and prolonged light most plants, after this precocious development, seemed to suffer from the effects of excessive assimilation, but some kinds adapted themselves to the extraordinary conditions. Among the latter were bulbous plants, grasses, arborescent species, and plants which grow under water.

Observations on the structure of the leaves of the plants which showed the extraordinary growth above mentioned, indicated that the palisade tissue is larger and the thickness of the blade and the number and size of the woody fascicles are greater under the continuous than under the discontinuous electric light and under the covered than under the naked light. The general form of the leaves also may be changed. In the plants which were able to resist long exposure to the intense light the organs which developed late had a different structure from that of those developed early. Plants exposed to the naked light had their tissues hypertrophied or presented abnormal formations in some parts. As a result of the investigations of herbaceous plants thus far made, the following general conclusions are drawn:

(1) Continuous electric light under glass causes in herbaceous plants an extraordinary growth, with intense green color, the structure of the organs being at first strongly differentiated; but if the exposure to the intense light is continued for months without interruption the new organs formed by the plants able to adapt themselves to the conditions of this light present remarkable structural modifications in their different tissues, being less differentiated though always rich in chlorophyll.

(2) By reason of its ultra-violet rays, the naked electric light hinders the normal development of tissues, even when the lamp is more than 3 meters distant from the plant.—A. C. T.

Well waters, F. T. SHUTT (*Canada Experimental Farms Report for 1891, pp. 179–183*).—Tabulated analyses of 29 samples of drinking water, accompanied by brief descriptions of the wells and their surroundings, and general remarks on waters and water supplies.—W. H. B.

Soils, F. T. SHUTT (*Canada Experimental Farms Report for 1891, pp. 152–157*).—A discussion of "the amount and functions of the more important elements of plant food in soils," accompanied by tabulated analyses of 18 samples of surface soils and 6 samples of subsoils, representing large areas, and in many cases virgin soils of Canada, and of 3 samples of alkali soil from Manitoba and the Northwest Territories. These analyses are discussed and means of improving the various soils are suggested.—W. H. B.

Investigations of the "adsorptive" capacity and the hygroscopicity of soil constituents, A. FREIHERRN (*Forsch. auf. Geb. Agrikulturphysik, 15 (1892), pp. 163–228*).—At the outset it is explained

that the word "adsorption" is adopted as a desirable substitute for the terms absorption and condensation, heretofore employed by agricultural physicists, and denotes the condensation of gases by solid bodies, as distinguished from the fixation of plant food from solutions on the one hand and from the absorption of vapor of water or hygroscopicity on the other.

The article contains (1) a summary of general literature (pp. 9), (2) a review of special literature (pp. 15), and (3) an account of original investigations (pp. 41).

The investigations of the author included tests of the influence of the fineness of the soil particles and of temperature on adsorption of ammonia and hygroscopicity, influence of temperature and relative humidity on hygroscopicity, influence of soil moisture on absorption of gases, and the time factor in hygroscopicity.

The substances used—quartz of different degrees of fineness, kaolin, humus, iron hydroxide, carbonate of lime, and soil mixtures contaning varying proportions of kaolin, quartz, and humus—were carefully dried and introduced into specially devised U-tubes provided with stopcocks at each end. After weighing, the tubes were so arranged in a water oven, the temperature of which could be readily controlled, as to allow the various gases, etc., to be passed through them. The weighings before and after the operation, corrected for temperature, pressure, etc., furnished the data for calculating the amount of gas or vapor retained by the different substances.

The essential facts observed may be summarized as follows:

All the soil constituents possess a considerable capacity for retaining gases and vapor of water, as the following table will show:

	Vapor of water (saturated air).		Ammonia.		Carbonic acid.	
Absorbed at 0° C. by—	*Grams.*	*c. c.**	*Grams.*	*c. c.*	*Grams.*	*c. c.**
100 grams of quartz	0.159	197	0.107	145	0.023	12
100 grams of kaolin	2.558	3,172	0.721	947	0.329	166
100 grams of humus	15.904	19,722	18.452	24,228	2.501	1,264
100 grams of $Fe_2(HO)_6$	15.512	19,236	4.004	5,275	6.975	3,526
100 grams of $CaCO_3$	0.224	278	0.256	320	0.028	14

* Reduced to 0° C. and 760 millimeters pressure.

The action of a soil mixture is determined by that of its individual constituents.

For the same substance adsorption increases with the fineness of its particles.

Between 0° and 30° C. adsorption decreases with the rise of temperature.

In the absorption of moisture from saturated air the absolute water content increases with the temperature. In this case the increasing moisture content nearly neutralizes the effect of temperature. If, however, the absolute water content of the air remains constant while the

temperature rises, a like influence of temperature is shown as in case of adsorption of gases.

Temperature remaining constant, hygroscopicity increases with the relative humidity.

If the soil is more than hygroscopically moist, absorption of gases by soil water takes the place of true adsorption.

Raising the temperature accelerates the process of condensation.—W. H. B.

Liming of stiff clay soils, A. F. HOLLEMAN (*Landw. Vers. Stat.*, *41* (*1892*), *pp. 37–41*).—It is a well-known fact that liming greatly improves the physical condition of stiff, impervious clay soils. This result appears to be due to the power of lime solutions to flocculate and precipitate suspended matter. When the soil water contains a sufficient amount of lime the clay particles which would otherwise close the interstices of the soil are flocculated and thus prevented from hindering circulation. It follows, therefore, that the stiffness of a soil bears a certain relation to its lime content.

As a contribution to the study of this question 21 samples of soil were tested for water-soluble and carbonic-acid-soluble lime, and afterwards treated with gas lime to observe the effect on their physical condition. In the sixteen cases in which the addition of lime resulted in improvement the soils showed 0.15 per cent or less of lime soluble in carbonic acid. Those soils in which the proportion exceeded 0.5 per cent were not benefited by liming. Such soils appear from the tests made to be deficient in humus, and it is probable that applications of organic manures would prove beneficial to them.—W. H. B.

The use of sulphate of iron in agriculture, H. BOIRET and G. PATUREL (*Ann. Agron.*, *18* (*1892*), *pp. 417–440*).—The history of experiments with sulphate of iron as a fertilizer is reviewed.* These investigations have shown that all plants contain iron and that they will not grow in a medium absolutely free from it, and that although soils generally contain an almost inexhaustible supply of this element, it has sometimes been found that additions of ferrous salts, particularly the sulphate, will produce an increase in yield. For the purpose of studying this question three series of experiments were carried out at the Grignon Station, as follows: (1) Water cultures, to determine what strength of sulphate of iron is poisonous to plants; (2) cultures in artificial soils, to study the action of sulphate of iron in the presence of a given quantity of carbonate of lime; and (3) experiments on natural soil, to compare yields under natural conditions.

From observations on growth and the chemical analysis of the product in each case, the following conclusions are drawn: Sulphate of iron is poisonous either in itself or on account of the acid which it sets free in passing to the state of basic ferric sulphate. It is used to advantage, therefore, only for producing certain secondary reactions. In

*Especially those of A. B. Griffiths, Chem. News, 1884–'85.

a calcareous soil sulphate of iron transforms rapidly, giving sulphate of lime and oxide of iron. Almost any quantity of sulphate of iron may be applied without hindering growth to any considerable extent, provided sufficient lime is present and planting is not done until several months after the amendment is incorporated in the soil. Sulphate of iron, like plaster, acts principally in promoting the diffusion of potash. In soils poor in assimilable potash it may replace plaster for legumes and certain other plants of like requirements, such as potatoes, beets, and grapes. Aside from these special cases, however, it is not believed that in practice anything is to be gained by adding this substance to formulas for manures.—W. H. B.

Analyses of fertilizing materials, F. T. SHUTT (*Canada Experimental Farms Report for 1891, pp. 138–164*).—Analyses of muck (19 samples); lake, river, salt, and mussel mud (7 samples), and peat, eel grass, spent tan bark, and ammoniacal gas liquor (each 1 sample), with brief discussions of their value and use as manure.—W. H. B.

Experiments with field crops at Canadian stations, W. SAUNDERS and T. A. SHARPE (*Canada Experimental Farms Report for 1891, pp. 5–62 and 235–340*).—An account is given of the distribution of seeds of oats, barley, wheat, peas, spring rye, potatoes, and corn, with reports on the results obtained in various localities. Tabulated and descriptive notes are also given on tests at the Central Experimental Farm of 48 varieties of oats, 26 of two-rowed and 19 of six-rowed barley, 38 of spring wheat, 10 of peas, 15 of mangel-wurzels, 10 of sugar beets, 15 of carrots, and 111 of potatoes. There are also similar accounts of tests of varieties of these crops at the other experimental farms in the Dominion. The yields of two-rowed barley in Canada and a report of English brewers on samples sent them indicated that with care in the selection of seed and thorough cultivation a satisfactory trade in this kind of barley may be established. The results of experiments with spring wheat, oats, and barley favor early seeding. Tests of the vitality of 2,757 samples of seeds of cereals, grasses, and vegetables gave an average percentage of 85.9 of good seeds. Among seeds giving relatively low percentages were those of grasses, beets, and onions. Experiments in growing and storing corn for silage are briefly described.—A. C. T.

Experiments in horticulture at Canadian stations, J. CRAIG and T. A. SHARPE (*Canada Experimental Farms Report for 1891, pp. 116–148 and 269–340*).—In the report of the horticulturist of the Central Experimental Farm the effects of the cold of the winter of 1890–'91 on a number of varieties of apples are described. Brief notes are given on 28 varieties of Russian apples. There are also tabulated and descriptive notes on 51 varieties of black, 35 of red, and 32 of white grapes, and accounts of tests of varieties of raspberries, blackberries, currants, gooseberries, beets, cauliflowers, celery, peas, peppers, and tomatoes. Experiments with fungicides for apple scab and grape and gooseberry mildew are reported. Accounts are also given of exper-

iments with varieties of fruits and vegetables at experimental farms in different parts of the Dominion.—A. C. T.

Report of entomologist and botanist of Canadian stations, J. FLETCHER (*Canada Experimental Farms Report for 1891, pp. 190–220, figs. 15*).—Notes on the eye-spotted bud moth (*Tmetocera ocellana*), cigar case bearer of the apple (*Coleophora* n. sp.), pear leaf blister mite (*Phytoptus pyri*), clover root borer (*Hylesinus trifolii*), oat weevil (*Macrops porcellus*), red turnip weevil (*Entomoscelis adonidis*), and pea weevil (*Bruchus pisi*). Analyses of apples sprayed twice during June with Paris green did not show any trace of the arsenic on the fruit. The oat weevil is reported as showing a decided preference for the wild grass *Panicum crus-galli*. Experiments in the germination of peas infested with weevils agree with those reported in Bulletin No. 19 of the Kansas Station (E. S. R., vol. III, p. 18) in showing that such peas should not be used for seed. The fallacy of the opinion that peas infested with weevils will float in water is pointed out. Brief accounts are given of tests of a number of species of grasses and descriptions of several common weeds.—A. C. T.

Fodders, F. T. SHUTT (*Canada Experimental Farms Report for 1891, pp. 165–178*).—Analyses are given of a number of varieties of carrots, turnips, sugar beets, and mangel-wurzels; determinations of the dry matter in several varieties of fodder corn at different stages of growth; examinations of 64 varieties of sugar beets; tests of sorghum; remarks on the Babcock milk test; and analyses of several brands of condensed milk. It is recommended to harvest corn for fodder when the kernels begin to glaze. "The stalks at this time are beginning to turn yellow near the ground. If allowed to remain standing after this period the digestibility of the fodder may be impaired. If intended for the silo and the weather permits, it should be left to wilt for two or three days after cutting. Sweeter silage results, as a rule, by this method than by at once drawing in and filling the silo."—E. W. A.

Digestibility of food under varying conditions, H. WEISKE (*Landw. Jahrb., 21, pp. 790–807*).—The experiments here reported were made with a view to determining the effect, if any, which the practice of adding lime to feeding stuffs, as silage and distillery slop, to correct their acidity, has upon the thoroughness of digestion—whether the calcium salts of organic acid thus formed and the excess of lime added diminish the digestibility of the food by partially neutralizing the acids of the stomach.

Two separate trials were made with rabbits, four animals being used in each case. Each animal was kept by itself in a box lined with tin, and having a bottom of wire gauze, below which was a funnel for collecting the urine. In the first trial the rabbits all received meadow hay and a little beet diffusion residue, and in the second trial dried oats; and in each trial two rabbits received in addition 2.5 grams of chalk each per day. Each trial lasted twenty days, the feces and urine being collected the last ten days. In the feces determinations were made of

the total nitrogen, and that soluble in warm water and in pepsin solution. It was found in the experiment with hay that, as between the lot with and without lime, there was no material difference between the amount of nitrogenous material dissolved from the feces by warm water, but pepsin solution dissolved more by 6.57 and 8.72 per cent, respectively, from the feces of the lot receiving lime; that is, the indications were that the continued feeding of lime with a hay diet resulted in the protein of the food being less thoroughly assimilated by animals, since a considerable excess of pepsin-soluble proteids passed on into the feces. In the trial with oats, however, there was no material difference between the amounts of nitrogenous material dissolved from the feces of the two lots by either warm water or pepsin solution, which could be attributed to the effect of the carbonate of lime. The percentages of food ingredients digested by the two lots averaged as follows:

Digestibility of oats by rabbits and by sheep.

	By rabbits.			By sheep, Wolff's averages.*
	With carbonate of lime.	Without carbonate of lime.	Difference.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Dry matter	68.24	63.33	+ 4.91	....
Organic matter	70.00	64.34	+ 5.66	68
Crude ash	53.27	29.20	+24.07	....
Crude protein	65 40	66.75	− 1.35	77
Crude fat	94.04	93.59	+ 0.45	82
Crude cellulose	12.66	19.61	− 6.95	....
Nitrogen-free extract	76.96	67.85	+ 9.11	73

* Landw. Fütterungslehre, p. 239.

According to the above averages, the lot receiving carbonate of lime digested the protein and cellulose less completely and the other ingredients more completely than the lot receiving no carbonate, although the differences in some cases are only small.

The disagreement between the apparent effects of calcium carbonate in the hay and in the oats-ration, the author suggests, may be due to the difference in character of these feeding stuffs. While hay is a wholly normal food for Herbivora and gives an alkaline ash, oats are not adapted to exclusive feeding of rabbits, as has been shown by the author on previous occasions,* and gives an ash with a strongly acid reaction on account of the amount of acid phosphates it contains. He suggests that a further addition of bases to an exclusive hay diet might be expected to prove disadvantageous to the action of the juices of the stomach in digesting the nitrogenous constituents of the food, while this would not be expected in case of the oat diet.† It has been shown that an alkaline reaction is favorable to the digestion of starch, and since the nitrogen-free extract of oats consists largely of starch, the addition of calcium carbonate might be expected to neutralize the acid ash

* Land. Vers. Stat., 39, p. 241; 40, p. 81.

† The favorable effect of calcium carbonate fed to rabbits on an exclusive oat diet has been shown by the author in previous experiments.

ingredients and so favor the digestibility of this class of ingredients. The figures above indicate that this was the case, for the percentages of the nitrogen-free extract digested by the rabbits with and without calcium carbonate were 76.96 and 67.85, respectively. The digestibility of the crude fiber, *i. e.*, its fermentation, seems to have suffered from the addition of calcium carbonate, as the amounts digested by the rabbits with and without calcium carbonate were 19.61 and 12.66 per cent, respectively. If the digestible nitrogen in the feces, *i. e.*, that soluble in pepsin solution, be deducted from the total nitrogen of the feces, the coefficients of digestibility for the protein (Nx 6.25) will be as follows:

		Per cent.
Carbonate of lime	Rabbit 1	83.17
	Rabbit 2	85.60
No carbonate of lime	Rabbit 3	81.73
	Rabbit 4	84.97

These figures are about 18 per cent higher than those given in the table above, where no account was taken of the pepsin-soluble nitrogen. This pepsin-soluble product is not regarded as all metabolic nitrogen, as it contained digestible albuminoids besides. Artificial digestion of the same oats showed 88.43 per cent of the protein to be soluble in pepsin solution (Stutzer's method). The author doubts the accuracy of these coefficients for protein. While the amount of proteids dissolved from the feces by pepsin falls within the commonly accepted limit for metabolic nitrogen (0.3 to 0.5 gram of nitrogen per 100 grams of digested organic matter), it is not all regarded as metabolic nitrogen, since it is believed that the pepsin-soluble product contained digestible albuminoids, as was the case with that from the hay-fed rabbits. Furthermore, he does not recognize a constant relation between digested organic matter and metabolic nitrogen for all kinds of animals and all feeding stuffs or rations, and refers to recent work by E. von Wolff* as supporting this view.

The experiments with an exclusive oat diet were extended to sheep, one grown sheep which had previously been fed on hay receiving 1,000 grams of oats per day from February 20 to March 2, and the excreta being collected and analyzed the last four days. The coefficients of digestibility found in this trial, and for comparison those found in the trials with rabbits and those given by Wolff for sheep and horses, are given as follows:

Coefficient of digestibility for oats found under different conditions.

Kind of animal.	Number of experiments.	Rations.	Organic matter.	Crude protein	Crude fat.	Crude cellulose.	Nitrogen-free extract.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Sheep	1	Oats exclusively	71.93	64.50	58.03	17.22	81.75
Rabbits	2	......do	64.34	66.75	93.59	19.61	67.85
Horses	8	Oats and coarse fodder	67.97	85.83	71.38	21.04	73.53
Sheep	13	......do	71.28	79.92	82.98	29.88	75.99
Sheep	2	300 grams oats and 900 grams hay	79.40	87.65	82.24	53.38	82.10
Sheep	2	600 grams oats and 900 grams hay	76.48	85.96	83.23	43.89	79.84

* Landw. Jahrb., 19, p. 797.

After calling attention to the points of difference the author concludes that there can hardly be a doubt that the solid excreta may contain, besides nitrogenous metabolic products. a variable quantity of undigested albuminoids soluble in artificial-digestion solutions, the amount of these latter varying with the manner of feeding, kind of animals, and even with the individual. Artificial digestion tests, he says, always give the maximum percentage of digestibility of the protein and have therefore only a limited value. They can be expected to coincide with the results obtained on animals only when the method of feeding is rational and the condition of the animals wholly normal. Where these conditions do not prevail artificial digestion gives too high results. While recognizing the value of artificial digestion trials for certain purposes, he believes that they can never fully replace feeding experiments with animals.—E. W. A.

Feeding steers, J. W. ROBERTSON (*Canada Experimental Farms Report for 1891, pp. 67–70*).—Six 2-year-old Shorthorn steers, averaging about 1,135 pounds each in live weight, were divided into three nearly equal lots and fed from December 29 to May 18, to compare different coarse fodders. All received the same grain ration, but lot 1 received hay and turnips *ad libitum.* The hay was valued at $8, the turnips at $4, and the silage at $1.40 per ton. Lot 1 (hay and turnips) gained 367 pounds, at a cost of 19.23 cents per day for food; lot 2 (silage) gained 433 pounds, at a cost of 11.9 cents per day; and lot 3 (hay, turnips, and silage) gained 310 pounds, at a cost of 15.58 cents per day. The results, both as far as total gain and cost of food were concerned, were in favor of the silage. One steer of lot 3 did not thrive a part of the time; the other steer made a gain about equal to that of lot 1. "During the last month of the testing period steers Nos. 3 and 4, on corn silage and meal, gained in weight much faster than the others, and when the experiment was finished they were in more attractive condition for handling and selling."—E. W. A.

Feeding mangel-wurzels vs. sugar beets for a short period, J. W. ROBERTSON (*Canada Experimental Farms Report for 1891, pp. 79, 80*).—An experiment with twenty-three milch cows, lasting about three weeks, indicated no appreciable difference in the quality of the milk due to the substitution of sugar beets for mangel-wurzels. The butter made on the sugar beet ration was judged to be of firmer body and finer flavor than that made on the mangel-wurzel ration.—E. W. A.

Feeding milch cows, J. W. ROBERTSON (*Canada Experimental Farms Report for 1891, pp. 72–79*).—An experiment was made to determine the effects of substituting corn silage for hay and roots, and *vice versa.* Eighteen cows were divided into six lots and fed for three periods of four weeks each. The lots all received the same grain ration, but the coarse food was changed in the different periods and for the several lots in accordance with the purpose of the trial. The analyses of the milk are not given, so the conclusions reached apply only to the yield of milk.

The teaching of the experiments points to the economy of—

(1) Providing for milch cows a ration of succulent quality.

(2) Feeding as large a quantity of the feed as the animals will eat up clean.

(3) Making the ration of such a gross and bulky composition that not more than from 6 to 8 pounds of meal—the concentrated and expensive part of the feed—will be consumed by the ordinary cow per day.

Corn silage of such a quality as came from our silos was not in itself a complete or suitable feed for milch cows. During the period when it was fed alone the hair of the cows seemed dry, there was an absence of thrifty appearance, and the yield of milk fell off in the first period of four weeks by 22.6 per cent. There was an average gain of 6.5 per cent in the yield of milk during the first period of four weeks from the cows in each of the other five lots. E. W. A.

Experiments in fattening pigs, J. W. ROBERTSON (*Canada Experimental Farms Report for 1891, pp. 83–87*).

Steamed vs. raw food.—To compare the gain in weight of pigs on steamed food fed hot and the same food unsteamed fed cold, two lots of four pigs each were fed from December 9 to May 18. At the beginning of the trial the pigs averaged about 75 pounds each in weight. The food consisted of a mixture of ground peas, barley, and rye, and the pigs all had access to salt and ashes. During the whole trial the lot fed on steamed food gained 702.5 pounds and the lot on raw food 564 pounds; but the first lot ate the most, so that the amount of food consumed per pound of gain is about equal in the two cases—4.16 pounds and 4.25 pounds, respectively.

Sugar beets and pea silage for pigs.—Two lots of eight pigs, averaging about 60 pounds in weight, received a mixture of ground peas, barley, and rye, with sugar beets and pea silage, respectively, from December 29 to May 18. To half of each lot the grain was fed steamed and to the other half raw. The pea silage was made from peas harvested when the pods were full but the peas still soft. The vines were green and succulent. The silage kept well, but the pigs refused to eat much of it. The results show no striking differences between the gains on the pea silage and on the sugar beet rations, or between the amounts of cooked and raw food consumed per pound of gain.

"On the average there is a gradual increase in the quantity of food consumed for every pound of gain in live weight of swine after the second month of their feeding period and after the average live weight exceeds 100 pounds. It is economical to market swine for slaughtering when they weigh from 180 to 200 pounds alive."—E. W. A.

Report of poultry manager, A. G. GILBERT (*Canada Experimental Farms Report for 1891, pp. 221–234*).—This report contains an account of the treatment of the poultry on trial, the number of eggs laid by different breeds, incubation trial, treatment of chickens, preservation of eggs, weight of eggs, etc. Feeding trials at the farm have led to the following conclusions:

(1) No hens should be kept over two years, because after that age they molt so late that the prospective profit is eaten up before they begin to lay.

(2) No soft-shelled eggs were laid by the pullets, showing that they are not as likely to do so as the old stock, and that the daily mixing of coarse sand, fine gravel, and sifted oyster shells in small quantities has a preventive tendency.

(3) No eggs nor feathers having been eaten to date of writing, the regular supply of ground meat, mixed in soft feed, is to be recommended.

(4) A small quantity of salt was mixed daily in the hot morning ration, but as it created looseness among the Brahmas, Cochins, and several Plymouth Rock hens, its use was given up.

(5) The feeding of vegetables, viz, carrots, mangel-wurzels, turnips, etc., in generous quantity, had the effect of keeping the hens in excellent condition, and is necessary for the production of eggs.

(6) Scattering the grain food among the straw and chaff always on the floors of pens kept the fowls (particularly the young ones) active. This grain food should not be fed in too great quantities. E. W. A.

Investigations on the variation in composition of milk from fractional milkings, H. KAULL (*Ber. landw. Inst., Halle, Heft 8, pp. 1-20*).—Although it has been shown repeatedly that the milk drawn first in milking is very poor in fat as compared with that drawn last, the author claims that no satisfactory explanation of the cause of this has ever been made. Various theories have been suggested, prominent among which are those of Fleischmann, Hofmann, Schmidt-Mühlheim, and Mendes de Leon.

Briefly considered, the Fleischmann theory assumes a mechanical adhesion of the larger fat globules to the walls of the milk ducts, which during milking are washed down into the milk cistern by the newly secreted milk. This theory supposes a continual secretion of new milk during milking, which Hofmann and Schmidt-Mühlheim are both inclined to regard with doubt, although they both agree with Fleischmann in attributing the cause of the increased richness of the last milk to some peculiarity in the behavior of the fat globules rather than to an increased activity of the mammary glands. Schmidt-Mühlheim suggests that a thorough washing out of the fat globules from the fine milk ducts is impossible during milking, but after milking these fatty residues from the last milking swim down into the milk cistern with the newly secreted milk, there to undergo a sort of creaming process, as a result of which the milk first drawn out is very poor in fat. The theory suggested by Mendes de Leon, on the contrary, assumes that during and at the close of milking the secretion of fat globules is relatively more extensive than at first. His theory rests upon the basis that the milk fat instead of being formed in the mammary glands by fatty degeneration, is largely derived from the fat in the food; that the blood, and probably the white corpuscles, are the medium through which this transmission of fat takes place; and that the act of milking stimulates the veins leading to the glands to activity, resulting in an increased accumulation of white corpuscles in the glands and thus of fat, without affecting the composition of the milk serum. He admits, however, that a mechanical adhesion of the fat to

the fine milk ducts may be an additional cause for the richness of the last milk.

After a hasty review of the literature of the subject, the author reports the results of an experiment by himself, in which the milk of one gland of a Holland cow was milked in three fractions at each milking, the first fraction consisting of the first 100 to 150 c. c. drawn, the third of an equal quantity drawn last, and the second or middle of all the remaining milk. The cow was milked at 5 a. m., and then through the day at intervals of six, four, and two hours, each time in the manner described above. Besides these, milk was drawn at short intervals—fifty, sixty-five, and thirty-five minutes—to ascertain the composition of the freshly secreted milk. The samples were analyzed with the following results:

Composition of milk from fractional milkings.

Time since last milking, and fractions.	Total solids.	Fat.	Total albuminoids.	Sugar.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Twelve hours:					
First fraction	9.78	0.79	3.11	5.15	0.73
Second fraction	11.28	2.68	2.94	4.94	0.72
Third fraction	17.15	9.01	2.75	4.72	0.67
Fifty minutes	16.14	7.91	2.71	4.86	0.67
Sixty-five minutes:					
First fraction	11.63	2.53	3.21	5.11	0.78
Second fraction	11 76	3.08	3.01	4.89	0.78
Third fraction	13.56	5.07	2.94	4.83	0.72
Thirty-five minutes	12.51	4.23	2.78	4.76	0.74
Two hours:					
First fraction	11 21	1.98	3.19	5.26	0.78
Second fraction	11.55	2.52	3 07	5.19	0.77
Third fraction	13.61	5.27	2.74	4.81	0.79
Fifty minutes	12.59	4.04	2.84	4.92	0.79
Four hours:					
First fraction	10.14	1.75	2.77	4.84	0.78
Second fraction	12.27	3.57	3.05	4.89	0.76
Third fraction	14.29	6.02	2.78	4.73	0.76
Six hours:					
First fraction	9.11	0.55	2.70	5.09	0.77
Second fraction	10 99	2.52	2.74	4.99	0.74
Third fraction	14.14	5.13	3.28*	4.95	0.78

* Regarded as doubtful.

From the figures in the above table a calculation was made of the relative amounts of the several milk ingredients in 100 grams of fat-free milk. The indications which these figures furnished were that the several fractions of any single milking had all been secreted under like secretive conditions, and further that frequent milking had caused no change in the relative proportion of the separate milk constituents; in other words, the fat alone had been affected. These results were verified in a second experiment.

Regarding the effect of the act of milking in exciting the glands to secretion, the indications from the first experiment were that within certain limits (about an hour) frequent milking favored the secretion, as the amount of milk secreted per minute was 5.29 grams with an interval of twelve hours, and 6.83 grams with an interval of six hours, and

continued to increase until it reached 10.15 grams, when the interval was only sixty-five minutes. But a more potent factor than time is believed to be the quantity of milk in the udder, for this last seemed to regulate the activity of the glands; and it is suggested that the increased yield by frequent milking may be due rather to the relative emptiness or fullness of the udder than to any stimulating effect of milking.

Further experiments were then made to study more closely the effect which the quantity of milk in the udder might have upon the activity of the mammary glands. A Holland cow was milked as dry as possible after a night's intermission of twelve hours. During an hour and a half immediately following this milking the left gland was emptied four times at intervals of fourteen to eighteen minutes between milkings, while the right gland was not emptied until the expiration of the hour and a half. The total milk yield of the left gland in the four milkings was 1.03 pounds, and of the right gland at the single milking 1.83 pounds. Repetition gave the same result. Too frequent milking was disadvantageous to the milk secretion. The amounts of milk secreted by the two glands, when both were milked in the same manner, were found to be practically alike. This result, *i. e.*, the disadvantage of too frequent emptying of the glands, is contrary to the theory that the formation of milk takes place under the stimulus of the act of milking.

Just how the relative amount of milk in the udder affects the process of milk secretion the author admits that his experiments do not make clear. The principal results of his experiments are summarized as follows:

(1) The secretion of any single ingredient, as fat, is not affected by the act of milking, and a "milking stimulus," in the sense in which Mendes de Leon uses the term, does not exist.

(2) No considerable formation of milk takes place during milking.

(3) Too frequent milking and allowing the milk to remain in the glands too long both tend to diminish the secretive activity of the glands.

(4) Frequent milking, within certain limits, may result in an increased production of milk, not through the act of milking itself, but through the emptying of the glands.

The process of milking in itself is without effect on milk production, but within certain limits frequent emptying of the glands favors increased milk production.—E. W. A.

Experimental dairy work, J. W. ROBERTSON (*Canada Experimental Farms Report for 1891, pp. 88–104*).—*Deep setting of milk at different temperatures* (p. 89).—During six days mixed herd milk was set at 78°, 88°, and 98° F., in deep cans submerged in ice water at 49° in each case, and skimmed after twelve hours. The average percentage of the fat in the skim milk was 0.71 when set at 78°, 0.64 at 88°, and 0.62 at 98°. The percentages of the total fat in the milk lost in the skim milk were 17.6, 15.63, and 15.4, respectively.

Immediate vs. delayed setting of milk (pp. 89, 90).—From July 27 to August 2 mixed herd milk from each milking was divided into two parts, one part being set at once and the other left in the pail in the dairy room for an hour before setting. All the settings were in deep cans submerged in ice water and the skimming was done after twenty-one or twenty-two hours. The total loss of fat was 11.48 per cent greater with delayed setting than with immediate setting.

Duration of setting (pp. 90, 91).—From August 12 to 18 comparative trials were made of setting mixed herd milk in deep cans in ice water for eleven and for twenty-two hours. The average percentages of fat in the skim milk for the mornings' and evenings' milk were as follows: Setting eleven hours 0.98 and 0.97, setting twenty-two hours 0.55 and 0.65, respectively. The total loss of fat with the skim milk by setting eleven hours was 9.9 per cent greater from the mornings' milk and 6.22 per cent from the evenings' milk than by setting for twenty-two hours.

Effect of adding water to milk in deep setting (p. 91).—For six days, September 24 to October 1, the mixed herd milk from each milking was divided into three equal parts, one part diluted one fourth with water at 160° F., another part diluted one fourth with water at 60°, and the third part set without dilution. The samples were all set in cans submerged in ice water. The average results showed practically no difference in the loss of butter fat by the three methods of treatment.

Creaming milk from cows in different stages of lactation by deep setting (pp. 91–94).—Four experiments were made in November in creaming the milk of cows which had been giving milk eight to eleven months, five to seven months, and one to three months. The groups of cows in different stages of lactation included Shorthorns, Jerseys, Holsteins, Devons, Ayrshires, and a Polled Angus, and the number of cows of each breed was not the same for all the groups. The milk was set for twenty-two hours in deep cans, in water ranging in temperature from 38° to 47° F. In one experiment the milk was heated to 98° F. before setting and in another the setting was delayed for half an hour. The average loss of fat in the skim milk was as follows:

Losses of fat in creaming milk.

No. of experiment.	Treatment of milk.	Group I, cows 8 to 11 months in milk.	Group II, cows 5 to 7 months in milk.	Group III, cows 1 to 3 months in milk.
		Per cent.	*Per cent.*	*Per cent.*
1	Milk set in water at 47° F	27.34	35.00	22.42
2	Milk set in ice water	28.58	21.61	13.87
3	Milk reheated to 98° and set in ice water	34.29	24.40	12.04
4	Milk of groups I and II diluted 10 per cent with water, and of group III delayed half an hour, then reheated to 98° F	34.25	28.38	15.41
	Average of four experiments	31.11	27.35	15.93

The average results of these four experiments show that the total loss of fat in the skim milk amounted to 31.11 per cent with cows from

eight to eleven months in milk, 27.35 per cent with cows five to seven months in milk, and 15.93 per cent with cows from one to three months in milk.

Deep setting vs. shallow pan setting (pp. 94–96).—During the month of December a number of trials were made in which the milk of cows which had been giving milk from five to twelve months was set in deep cans in water at 45°, and in shallow pans to a depth of 2½ inches. In these trials the loss of fat was 40.27 per cent greater with deep setting at 45° than with setting in shallow pans. The use of ice in deep setting is believed to be necessary to obtain efficient creaming.

Setting in different-sized cans (p. 96).—This is a comparison between setting milk in a milk can 15 inches in diameter and in the ordinary shotgun can 8½ inches in diameter. In each case the milk stood about 19 inches deep in the cans and was set in ice water for twenty-two hours. The percentages of fat in the skim milk were 0.71 and 0.73 respectively (morning and evening) with the large can, and 0.45 and 0.47 respectively with the shotgun can, making the total loss of fat smaller with the shotgun can.

Churning cream from cows in different stages of lactation (pp. 96–100).—Three series of experiments were made to compare the results of churning cream raised by deep setting, from the milk of cows in different stages of lactation. In all cases the cream was raised in deep cans set in ice water for twenty-two hours. The cream was soured with a fermentation starter and ripened to as nearly the same degree of acidity as possible. The details of the trials are presented in the following table:

Results of churning cream from cows in different stages of lactation.

	Group I, cows 8 to 11 months in milk.			Group II, cows 5 to 7 months in milk.			Group III, cows 1 to 3 months in milk.		
	First trial.	Second trial.	Third trial.	First trial.	Second trial.	Third trial.	First trial.	Second trial.	Third trial.
Churning temperature (degrees F.)	64	64	70	64	64	64	62	62	62
Minutes churned	150	180	49	100	100	85	40	50	49
Revolutions of churn per minute	65	60	65	65	65	65	66	66	66
Percentage of fat left in buttermilk	0.20	0.45	0.35	0.30	0.35	0.15	0.20	0.30	0.20

The author concludes that in order to obtain the butter with from three quarters of an hour to an hour's churning, the cream from cows five to seven months in milk should be churned at a temperature between 66° and 70° F.; that the loss of fat in the buttermilk was practically the same for the three groups; and that the butter from cows more than five months advanced in milk "showed a decided absence of rosy and delicate flavor."

Churning sweet vs. sour cream (pp. 100, 101).—Two separate trials were made, one August 29 and the other September 10, in each of which 120 pounds of cream was thoroughly mixed and divided into

two equal parts, one part being ripened by the addition of a fermenation starter and the other kept sweet by keeping at 40° F. Portions of the sweet and sour cream and equal mixtures of the two were churned separately at a temperature between 59° and 62°. The sweet cream required to be churned longer and gave a smaller yield of butter than the sour cream. The fat left in the buttermilk was smallest with the sour cream and largest with the sweet cream. With the mixed cream the amount was about half way between.

Heating milk to 150° F. (pp. 101, 102).—To observe the effect of scalding milk upon the quantity, odor, and flavor of butter, two trials were made, in each of which about 350 pounds of mixed milk was divided into two lots, one being heated to 150° F. and the other set at once without heating. Both lots were set in each case in deep cans in ice water for twenty-two hours. The cream from each was ripened and churned in similar manner. About 4½ pounds more of the scalded milk was required to make 1 pound of butter, and the loss of fat in the skim milk and the buttermilk was 14.4 more than in the case of milk set at 96° F. "In both trials the butter from the milk which was not heated to 150° was decidedly better in flavor and odor than that from the other lots."

Heating cream to 150° F. (pp. 102–104).—In two trials made in heating cream to 150° F. before ripening, to observe the effect upon the odor and flavor of butter from cows fed on turnips, the results were favorable to the heating of the cream. When the cream was not heated the butter had a "distinct odor and flavor of turnips," but when the cream was heated to 150° the butter "had no flavor or odor of turnips and was decidedly better in every respect." Samples of the butter were kept in glass jars for four and one half months and reëxamined with the same result. Nearly 1 pound more of milk was required per pound of butter when the cream was not heated than when it was heated to 150°. The percentage of fat lost in the buttermilk was practically the same by both methods of treatment.—E. W. A.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

On the determination of nitrogen by the Kjeldahl method (*Zur Bestimmung des Stickstoffs nach der Kjeldahl'schen Methode*), O. BÖTTCHER.—*Landw. Vers. Stat., 41, Heft 3, pp. 170–173.*

Determination of nitric nitrogen (*Bestimmung des Salpeter-Stickstoffs*), O. BÖTTCHER.—*Landw. Vers. Stat., 41, Heft 3, pp. 165–169.*

The volumetric determination of alkaloids, A. H. ALLEN.—*Chem. News, 66 (1892), p. 259.*

Determination of glucose in leather (*Bestimmung des Traubenzuckers in Leder*), F. SIMAND.—*Zeitsch. angew. Chem., 1892, Heft 22, pp. 683–689.*

Note on the estimation of olein, L. DE KONINGH.—*Chem. News, 66 (1892), pp. 259, 260.*

Through what organs do leguminous plants absorb free nitrogen (*Durch welche Organe nehmen die Leguminosen den freien Stickstoff auf*)? P. KOSSOWITSCH.—*Bot. Ztg., 50, No. 43, pp. 698–702; No. 44, pp. 714–723; No. 45, pp. 730–738; No. 46, pp. 746–755; No. 47, pp. 771–774.*

On the exchanges of carbonic acid and oxygen between plants and the atmosphere (*Sur les échanges d'acide carbonique et d'oxygène entre les plantes et l'atmosphère*), T. SCHLÖSING, JR.—*Compt. rend., 115 (1892), No. 21, pp. 881–883.*

Artificial hybridization (*Hybridation artificielle*), DE CASTILLON.—*Rev. Hort., 64, No. 23, pp. 541, 542.*

The coloring matter of pollen (*Sur la matière colorante du pollen*), G. BERTRAND and G. POIRAULT.—*Compt. rend., 115 (1892), No. 20, pp. 828–830.*

Investigations on the production of perfume in flowers (*Recherches sur le mode de production du parfum dans les fleurs*), E. MESNARD.—*Compt. rend., 115 (1892), No. 21, pp. 892–895.*

On a new species of bacteria in the soil, Spirillum luteum (*Sur une espèce nouvelle de Bactérie chromogène le Spirillum luteum*), H. JUMELLE.—*Compt. rend., 115 (1892), No. 20, pp. 843–846.*

Vital and chemical fermentations (*Fermentations vitales et fermentations chimiques*), M. ARTHUS and A. HUBER.—*Compt. rend., 115 (1892), No. 20, pp. 839–841.*

Influence of humidity on the growth of plants (*Influence de l'humidité sur la vegétation*), E. GAIN.—*Compt. rend., 115 (1892), No. 21, pp. 890–892.*

Meteorological observations at Riga and Dünamünde in 1891 (*Meteorologische Beobachtungen in Riga und Dünamünde für 1891*), A. WERNER.—*Korrespondenzbl. Naturforsch. Ver. Riga, 35 (1892).*

Soil temperatures at Friedrichshof near Riga (*Erdtemperaturen in Friedrichshof bei Riga*), F. BUHSE.—*Korrespondenzbl. Naturforsch. Ver. Riga, 35 (1892).*

Penetration of the frost in differently treated soils in 1891–'92 (*Das Eindringen des Frostes in der Erdboden und dië Dicke des Eises auf der Duna im Winter 1891–'92*), R. BERNHARDT.—*Korrespondenzbl. Naturforsch. Ver. Riga, 35 (1892), p. 28.*

The chemical analysis of soils and its interpretation (*L'analyse chimique du sol et son interprétation*), L. MOTQUIN.—*Bul. Min. Agric. Belgique, 8, No. 5, pp. 188–199.*

The composition of the soils of Crau and of the waters and soils of Durance (*Recherches sur la composition des terres de la Crau et des eaux et limons de la Durance*), G. GASTINE.—*Bul. Min. Agric. France, 11, No. 5, pp. 389–418.*

Influence of the diffusion of fertilizers in the soil on their utilization (*Influence de la répartition des engrais dans le sol sur leur utilisation*), T. SCHLÖSING.—*Compt. rend., 115 (1892), No. 20, pp. 768–771.*

Analysis of fish guano, poudrette, bone meal, etc. (*Zur Analyse von Fischguano, poudrette, Knochenmehl und dergleichen Substanzen*), M. WEIBULL.—*Chem. Ztg., 1892, No. 90, pp. 1689, 1690.*

Results of recent experiments on the manuring of plants with nitrogen (*Ergebnisse der neusten Untersuchungen über die Ernährung der Pflanze mit Stickstoff*), R. OTTO.—*Deut. landw. Presse, 1892, No. 91, pp. 932, 933; No. 92, pp. 942, 943.*

Field experiments with fertilizers and crops in Campine, 1890-'91 (*Expériences culturales entreprises dans la région de la Campine pendant l'année 1890-'91*), C. SCHREIBER.—*Bul. Min. Agric. Belgique, 8, No. 5, pp. 117–144.*

Field experiments on the value of American red clover (*Ein Anbauversuche den Kulturwert des amerikanischen Rotklee betreffend*), F. NOBBE.—*Sächs. landw. Zeitsch., 1892, pp. 457–459.*

Inquiry regarding the starch content of different varieties of potatoes (*Enquête sur la richesse en fécule des diverses variétés de pommes de terre*), A. PETERMANN.—*Bul. Min. Agric. Belgique, 8, No. 5, pp. 145–176.*

Further contributions to the knowledge of the tobacco plant (*Weitere Beiträge zur Kenntniss der Tabakpflanze*), J. BEHRENS.—*Landw. Vers. Stat., 41, Heft 3, pp. 191–206.*

The pathogenic influence of ensiled beet pulp (*Étude sur le pouvoir pathogène des pulpes ensilées de betteraves*), ARLOING.—*Compt. rend., 115 (1892), No. 20, pp. 776–780.*

The chemistry of the development of the fruit of Pyrus salicifolia (*Zur chemischen Kenntniss der Fruchtentwickelung von Pyrus salicifolia*), M. E. JOHANSON.—*Korrespondenzbl. Naturforsch. Ver. Riga, 35 (1892), pp. 1–8.*

The manuring of grapevines (*Düngung des Weinstocks*), C. LIERKE.—*Sächs. landw. Zeitsch., 1892, pp. 513–518.*

On the carbohydrates of leguminous seeds (*Zur Kenntniss der in den Leguminosen-samen enthaltenes Kohlenhydrate*), E. SCHULZE.—*Landw. Vers. Stat., 41, Heft 3, pp. 207–229.*

The insects injurious to apples (*Les insectes nuisibles aux pommiers*), BROCCHI.—*Bul. Min. Agric. France, 11, No. 5, pp. 377–389, plate 1.*

Nutritive value of press cake from hops (*Le marc de houblon*), G. DE MARNEFFE.—*Bul. Min. Agric. Belgique, 8, No. 5, pp. 177–179.*

Determination of the value of rape cake according to its mustard oil content (*Ein Beitrag zur Beurteilung der Rapskuchen nach ihrem Senfölgehalt*), A. SCHLICHT.—*Landw. Vers. Stat., 41, Heft 3, pp. 175–190.*

A food preparation from peanuts (*Ueber Erdnussgrütze, ein neues fett- und stickstoffreiches Nahrmittel*), H. NOERDLINGER.—*Zeitsch. angew. Chem., 1892, Heft 22, pp. 689, 690.*

On dried distillery refuse (*Ueber getrocknete Schlempe*), G. UHLITZSCH.—*Sächs. landw. Zeitsch., 1892, pp. 435, 436.*

Effect of an increase or decrease in the amount of food consumed and of the calcium phosphate, sodium phosphate, or sodium citrate added to the food, on the digestion and assimilation of the food ingredients (*Ueber den Einfluss des vermehrten oder verminderten Futterkonsums, sowie der dem Futter beigegebenen Salze auf die Verdauung und Resorption der Nahrungsstoffe*). H. WEISKE.—*Landw. Vers. Stat., 41, Heft 3, pp. 145–164.*

Investigation on the method of elimination of carbonic acid from animals (*Recherches sur le mode d'elimination de l'oxyde de carbone*), L. DE SAINT-MARTIN.—*Compt. rend., 115 (1892), No. 20. pp. 835–839.*

Influence on tuberculous infection of the transfusion of the blood of dogs inoculated to prevent tuberculosis (*Influence sur l'infection tuberculeuse de la transfusion du sang des chiens vaccinés contra la tuberculose*), J HÉRICOURT and C. RICHET.—*Compt. rend., 115 (1892), No. 20, pp. 842, 843.*

The estimation of total solids in milk, H. D. RICHMOND.—*Analyst, Dec., 1892, pp. 225–227.*

On the Babcock method of milk analysis, F. T. SHUTT.—*Analyst, Dec., 1892, pp. 227–229.*

The action of some enzymes on milk sugar, H. D. RICHMOND.—*Analyst, Dec., 1892, pp. 222–225.*

Effect of oil cakes on the quality of butter (*Ueber die Einwirkung der Oelkuchen auf die Qualität der Butter*).—*Nordische Meierei Ztg.; abs. in Balt. Wochensch. Landw., 1892, No. 45, pp. 637, 638.*

EXPERIMENT STATION NOTES.

COLORADO COLLEGE.—The college has sustained a serious loss in the death of C. M. Brose, who for the past eight years has been connected with the botanical and horticultural department.

ILLINOIS COLLEGE.—A special course in agriculture will be given for the term beginning January 2 and ending March 22, 1893, to which students will be admitted without entrance examination or payment of fees. Courses of lectures will be given as follows: (1) Farm management; soils; crops, by Prof. Morrow and F. D. Gardner. (2) Stock-breeding, feeding, and management; dairy husbandry, by Prof. Morrow and F. D. Gardner. (3) Diseases of animals—causes, symptoms, and treatment, by Prof. McIntosh. (4) Vegetable physiology—life, nutrition, growth, and products of plants, by Prof. Burrill. (5) Elementary chemistry, by Prof. Palmer. (6) Chemistry of soils and plants by Prof. Parr. (7) Geology of soils, their origin and distribution, by Prof. Rolfe. (8) Insects injurious to crops, by Profs. Forbes and Sommers. (9) Diseases of crops—rusts, smuts, mildews, and blights, by G. P. Clinton. (10) Crop improvements—crossing, selecting, breeding varieties, by G. W. McCluer. (11) Milk—composition, testing; creamery and dairy experiments, by E. H. Farrington. (12) Special lectures on agricultural books and papers, agricultural organizations, and agricultural experiment stations.

Many of the lectures will be illustrated with experiments or with stereopticon pictures. The experiments in feeding and dairying in progress at the station will illustrate some of the courses, and the work of the station in other lines will be explained. A weekly clinic for treatment of diseased animals will be held.

MARYLAND STATION.—The position of machinist has been abolished and E. H. Brinkley, who held that position, has been appointed assistant agriculturist.

NEBRASKA UNIVERSITY.—A course of forty six lectures for farmers will be given at the university during eleven days, beginning February 20, 1893. The lectures will set forth in a condensed and popular form the latest results of investigations and experiments in the lines of which they treat.

WYOMING STATION.—A. Nelson has returned to the station after a year's absence and resumed his work as botanist. During the summer the acting botanist, B. C. Buffum, made a collection of grasses in different parts of the State for the station herbarium and for exhibition at the World's Columbian Exposition.

MÖCKERN STATION.—Dr. O. Kellner, of Japan, has been called to succeed Prof. Gustav Kühn, deceased, as director of the experiment station at Möckern, Germany.

THE EXPERIMENT STATIONS OF THE WORLD.—In a recent issue of *Die landwirtschaftlichen Versuchs-Stationen*, Dr. Nobbe enumerates 317 agricultural experiment stations, distributed as follows:

German Empire 67 (Prussia 35, Bavaria 10, Saxony 6, Wurtemberg 2, Baden 2, Anhalt 2, Hamburg 2, and Brunswick, Hess, Mecklenburg, Weimar, Meiningen, Oldenburg, Bremen, and Alsace 1 each), United States of America 54, France 53, Austria-Hungary 35, Sweden 24, Italy 17, Russia 14, Belgium 9, Switzerland 9, Denmark 8, Great Britain 8, Norway 4, Holland 4, Java (Dutch) 3, Portugal 3, Roumania 2, Spain 1, Brazil 1, Japan 1.

SOIL EVAPORATION.—The following is a brief account of experiments relative to the rate of evaporation of moisture from soil under different conditions, conducted

at the U. S. Experimental Grass and Forage Station at Garden City, Kansas, by J. A. Sewall: "I had the tinner make six stout galvanized iron boxes, each 1 foot square and 1 foot deep, capacity 1 cubic foot. I filled each of these June 7, 1892, with dirt taken from a trench 1 foot wide, 1 foot deep, and 6 feet long. To make the quantity of dirt *exactly* equal I brought each box to the same weight, 100 pounds, so I had *approximately* 1 cubic foot of earth and *exactly* 100 pounds. I then set the boxes back into the trench, bringing the surface of each box level with the level of the ground. I took them out on August 1 and weighed each again. In the mean time we had had 5.9 inches of rain. The boxes with their contents now weighed (the average) 107 pounds. The variation did not exceed $\frac{1}{4}$ of a pound. I did this to obtain a *constant* or to see if there would be a variation in the rate of evaporation under similar or constant conditions. I then returned the boxes to the trench as before, and covered three of them with 1 pound of oat straw ($\frac{1}{3}$ of a pound to each square foot), the other three being without covering. September 15, 1892, I took them out and weighed them. The weights of each group of three varied a little, but the average of the covered boxes was *9 pounds* greater than the average of the naked or exposed boxes. This is equal to a rainfall of $1\frac{3}{4}$ inches, or *189 tons* of water to the acre.

"My next experiment will be to cover the surface (about an inch) with *fine dirt (dust)*."

Experiments on the conservation of farm manures.—The German Agricultural Society has appropriated $10,000 for practical experiments on the treatment of barnyard manure. These experiments are to extend over several years, and it is hoped that they will settle the question of the best means of preserving barnyard manure. The following questions are to be especially considered: (1) What chemical means are best fitted for preventing loss of valuable qualities, and (2) what is the nature and extent of the losses which barnyard manure may suffer by lying in the field without proper treatment and how are these losses best prevented? Four years is allowed for completing the experiments. According to the plan prescribed, separate portions of the manure taken from the stables each day are to be treated with kainit, superphosphate-gypsum, precipitated phosphate-gypsum, and potash with phosphate-gypsum, respectively, and other portions to receive no admixture. Field experiments are to be made on different kinds of soil with the differently treated manures to study their immediate and after effects upon crops. The phosphate preparations will be especially manufactured for these experiments so as to secure uniformity in composition, and they, together with the other agricultural chemicals, will be furnished by the Society free of cost. Other experiments are to be made on the preservation of liquid manure according to the method proposed by Dr. J. H. Vogel (*Mitt. deut. landw. Ges.*, 1892, pp. 96, 97). The number of coöperators is limited to sixteen, and the Society reserves the right of making the selection of these. At the close of the experiments the coöperators will be paid $375, $300, or $225, according to the merits of their respective experiments.

Molasses as food for animals.—Prof. Maercker in a recent lecture speaks in high terms of the feeding of molasses mixed with sugar beet diffusion residue. The molasses resulting from beet sugar manufacture at present commands a very low price. It is sold largely to establishments which work it over for its sugar, potash, etc. Prof. Maercker has tested its value as a food for animals when mixed with sugar beet residue with very favorable results. It had no ill effect on the animals and the easily digestible carbohydrates it contains proved of value. He states that fattening sheep may be given 8 pounds of molasses per 1,000 pounds of live weight, oxen from 3 to 4 pounds, and milch cows about $2\frac{1}{2}$ pounds without the slightest danger, but that care should be exercised in feeding it to cows with calf. The molasses is to be fed mixed with dried diffusion residues in every case.

France.—Pasteur celebrates his seventieth birthday December 27. The French Academy of Science has planned a testimonial in his honor.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

NOVEMBER, 1892.

Preliminary Report of the Secretary of Agriculture for 1892.

DIVISION OF STATISTICS:

Report on Yield of Crops per Acre and on Product Compared with Last Year, November, 1892.

DIVISION OF BOTANY:

Bulletin No. 13, part I, October 20, 1892—Grasses of the Pacific Slope, Including Alaska and the Adjacent Islands.

DIVISION OF VEGETABLE PATHOLOGY:

Journal of Mycology, vol. VII, No. 2.

Bulletin No. 3.—Report on the Experiments made in 1891 in the Treatment of Plant Diseases.

DIVISION OF ENTOMOLOGY:

Insect Life, vol. V, No. 2, November, 1892.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. IV, No. 2, September, 1892.

WEATHER BUREAU:

Monthly Weather Review, September, 1892.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

NOVEMBER, 1892.

STORRS SCHOOL AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 9, November, 1892.—Soiling and Soiling Crops; Feeding Experiments with Soiling Crops.

GEORGIA EXPERIMENT STATION:

Bulletin No. 18, October, 1892.—Cheese and Butter-Making.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Bulletin No. 42, November, 1892.—The Potato—Relation of Number of Eyes on the Seed Tuber to the Product.

KANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 34, September, 1892.—Experiments in Feeding Steers.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 44, October, 1892.—Meteorological Summary for August and September; Feeding Experiments with Steers.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 46, October, 1892.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:
- Bulletin No. 22, August, 1892.—Comparison of Different Foods for Pigs.
- Bulletin No. 23, September, 1892.—Milling and Baking Tests; Coöperative Tests with Selected Seed Wheat; The Frit Fly—Preliminary Report upon an Insect Injurious to Wheat.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:
- Bulletin Nos. 22 and 23, October 1, 1892.—Corn Fodder Disease in Cattle and Other Farm Animals, with Especial Relation to Contagious Pleuro-Pneumonia in American Beeves in England.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:
- Bulletin No. 89, October 10, 1892.—Analyses and Valuation of Complete Fertilizers and Ground Bone.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:
- Bulletin No. 44, October, 1892.—The Pear Tree Psylla.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
- Bulletin No. 82*b*, February 27, 1892.—Fertilizer Analyses.
- Bulletin No. 83*b*, March 12, 1892.—Fertilizer Analyses.
- Bulletin No. 83*c*, March 26, 1892.—Fertilizer Analyses.
- Bulletin No. 83*e*, April 16, 1892.—Fertilizer Analyses.
- Bulletin No. 86*b*, June 15, 1892.—Fertilizer Analyses.
- Bulletin No. 87, September 15, 1892.—List of Publications of the Station from March, 1877, to September, 1892.
- Bulletin No. 87*a*, August 20, 1892.—Meteorological Summary for North Carolina, July, 1892; Proceedings of the First Meeting of the American Association of State Weather Services.
- Climatology of North Carolina.

OREGON EXPERIMENT STATION:
- Bulletin No. 20, September, 1892.—Experiments in Pig-Feeding.
- Bulletin No. 21, October, 1892.—The Soils of Oregon.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:
- Bulletin No. 19, September, 1892.—Fertilizers.

TEXAS AGRICULTURAL EXPERIMENT STATION:
- Bulletin No. 22, September, 1892.—Alfalfa Root Rot.

VERMONT STATE AGRICULTURAL EXPERIMENT STATION:
- Fifth Annual Report, 1891.

WYOMING AGRICULTURAL EXPERIMENT STATION:
- Bulletin No. 8, October, 1892.—Irrigation and Duty of Water.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:
- Bulletin No. 15, 1892.—Experiments in the Fattening of Swine.

EXPERIMENT STATION RECORD.

VOL. IV. JANUARY, 1893. No. 6.

The judgment of intelligent students of the work of our stations in field experiments is well expressed by Prof. Whitney in a recent publication as follows: "There has been no satisfactory interpretation as yet of much of the work which has been done on the chemical composition of soils and plants, and the results of plat experiments have in most cases been very conflicting and uncertain." These words suggest at the same time an important reason why field experiments seem so barren of useful results. It is because the chemist is the only scientist who has been called upon to aid in planning these experiments and examining their results. We have, it is true, advanced a step or two beyond the notions of the days of Liebig, when it was supposed that the chemical analysis of a soil was all that was needed to determine the crops to be grown and the fertilizers to be applied, but the evil traditions of that earlier time still have a potent influence. In most of the field experiments with fertilizers conducted by our stations the scientific data recorded are chemical analyses of the fertilizers, chemical analyses of the soil (even this is often omitted), and chemical analyses of the crop. After Mr. Warington had visited a number of our stations he expressed great surprise that so few of them were making systematic observations on the soils on which they were conducting field experiments. If one's reading were confined to accounts of field experiments by American investigators he would hardly be aware of the existence of such sciences as vegetable physiology, physics, and meteorology. Is it not strange that since chemical studies have thrown so much light on the problems of plant production it does not seem worth while to give at least as much attention to the questions which lie in the realm of these other sciences, especially when we find that the ever-increasing mass of chemical data is largely unintelligible when considered alone? While we keep the chemist as busy as ever with his agricultural work, shall we not give the physicist and the vegetable physiologist opportunity to apply their scientific knowledge to the soil and the plant? But it is not desirable that each

of these scientists should go off by himself and do all his work in the seclusion of his own laboratory. We want each to be aware of the existence of all the others and to submit his methods and results to their inspection and criticism. The specialist can make no greater mistake than to suppose that none but specialists in the same line can give him any helpful suggestions regarding his work. More than this, the different branches of science should be represented in the "council of war" when the plan of attack on any secret of nature is to be made. Scientists in various lines should take notes on the engagement as it proceeds, and after the contest is over the causes of the victory or defeat should be considered by the same council.

Prof. Johnson has observed that "next to temperature the water supply is the most influential factor in the product of a crop." What then shall we say of a field experiment with fertilizers in which no account is taken of the temperature of air or soil, rainfall, drainage, evaporation, circulation of soil water, or the water requirements of the crop? The physical conditions of the soil and the fertilizers would seem to be fully as important as their chemical constituents. Certainly the indiscriminate application of fertilizers to a soil whose physical as well as chemical characteristics are not well understood, is, to say the least, unscientific, and must lead to disappointment if anything more than mere indications of the requirements of a soil or plant are expected. There is a certain usefulness in the empirical application of various fertilizers in a systematic way upon a particular piece of land year after year. No doubt the individual farmer would do well to copy the station plats, at least to a limited extent, on his own farm, but it is becoming more and more clear that results of general value can not be obtained from plat experiments as ordinarily carried on. Because the chemist has not been able to remove all the difficulties in the way of field experiments it will not do to reject scientific advice; rather call in the whole faculty and insist on their working in harmony until the end is secured. There are investigators in agricultural science who realize the importance of this concert of sciences. The work of such men as Lawes, Gilbert, and Warington in England; Déherain, Berthelot, Schlösing, and Müntz in France; and Hellriegel, Wagner, and Wollny in Germany is convincing evidence of the good results which may flow from the combination of chemical and physical inquiries on agricultural problems. In our own country, too, the student of the works of Johnson and Storer ought to be impressed with the necessity of such a union of scientific effort. The citation of a few recent publications may serve to show that there is an increasing interest among us in widening the range of our studies on the complex questions involved in plant production. Prof. Whitney has recently published suggestive articles on the physical properties of soils and their relation to moisture and crop production (Weather Bureau Bul. No. 4, E. S. R., vol. IV, p. 371). Prof. E. W. Hilgard, of the University of California, has presented

another phase of the question in a bulletin on the relation of soil to climate (Weather Bureau Bul. No. 3, E. S. R., vol. IV, p. 276). The reports of Prof. F. H. King on investigations on the movement of soil waters as affected by fertilizers and tillage have brought out interesting facts (Annual Reports of the Wisconsin Station for 1889, 1890, and 1891, E. S. R., vol. II, pp. 432 and 442, and IV, p. 121; Weather Bureau Bul. No. 5).

While in many cases it may not be practicable or advisable to materially change the plan of field experiments already undertaken at the stations, it is certainly worth while to consider whether more intelligible and valuable results would not be obtained by supplementing the data now being collected with exact and regular observations on rain fall and drainage and on the physical conditions of the soils experimented with. In pursuing such a plan it might be necessary to reduce the number of plats in use at any one time, but of course it is the usefulness and not the extent of an experiment which determines its value.

The members of the Association of American Agricultural Colleges and Experiment Stations who visited the Sugar Experiment Station at New Orleans received a good object lesson on the control of soil moisture in field experiments. Several acres of level field are there underlaid with a system of pipes, which carry off the superfluous water after rains and through which water from the Mississippi River is conducted to irrigate the experimental plats in dry weather.

The rate and amount of drainage can be determined, as well as the amount of water supplied by irrigation. Data are collected which show the conditions of soil moisture promoting the most advantageous growth of certain crops on such a soil, and these conditions can be largely controlled by the experimenter. Thus one of the most important factors in plant production can be calculated with reasonable accuracy in field work and one of the greatest difficulties in the way of the success of plat experiments is removed. It is no argument against the use of such a system in experiment station work to say that it could not be used in practical farming. It is the duty of the stations to use the best methods for discovering general truths regarding the growth of crops. To do this the several factors entering into plant production must be determined and the part which each plays in the growth of the plant must be ascertained. Only by eliminating some of these factors is there any reasonable hope of getting a satisfactory answer to definite problems. The elimination should not be made simply by refusing to take these factors into account in experimental inquiries. This has been the too common practice in field experiments and has in many cases vitiated their results. But any method by which the value of any factor of plant growth can be determined beforehand or by which the conditions under which it contributes to the growth of the plant can be definitely controlled should be welcomed and adopted.

SUGGESTED EXPERIMENTS IN BREEDING.*

W. H. Brewer.

Practical breeding has become a greatly specialized art, and the natural laws involved are a very fit subject for experimental study at the stations. Although the general rules seem to be fairly well understood, nevertheless some of the fundamental laws of breeding are not yet established and will not be until proved by experiments made for this special end by trained biologists working according to scientific methods. For example, it is almost universally believed by practical breeders that "acquired characters" are sometimes, or at least to some degree, transmitted by heredity, and they practice accordingly. This belief has been so widely shared by scientists that until lately it has been a sort of scientific dogma. Within a few years, however, this dogma has been questioned by a large number of very eminent biologists, many of whom deny it *in toto* and claim that from the very nature and basis of heredity such transmission can not take place under any circumstances. Between the two extremes there is a considerable following which allows the possibility of the heredity of "acquired characters," but denies that it has any practical value in the evolution of species in nature, and consequently plays no part in the improvement of breeds by art. This uncertainty is so far-reaching in its applications and so important in its economic results that I suggest a few series of experiments to be made at agricultural experiment stations. The costly character of the best stock used in practical breeding and the cost of the means and appliances for breeding in its most advanced practice, place this out of reach of the stations. The experiments I suggest may be carried out with some small and inexpensive species of domestic animals. The experiments had better be made with mammals than with poultry, and the laws involved can be as well established by experiments on rabbits, guinea pigs, or even rats and mice as with the most expensive trotters or Shorthorns.

The eminent Prof. August Weismann and his followers claim that none of the changes produced on an animal after its birth are ever transmitted by heredity to its offspring, even in the slightest degree; that the changes in the parent due to nutrition, those which follow from increased or diminished function, the effects of mutilation, injury,

*Prepared for the convention of the Association of American Agricultural Colleges and Experiment Stations at New Orleans, November, 1892.

or disease, in short of "any of the external influences which act upon the body," never are and never can be, by any possibility, transmitted; that the fundamental causes of heredity absolutely forbid it.

I have yet to find the successful breeder who accepts this as an established law of nature; nor is it accepted by all biologists. I think therefore that experiment stations, established for the investigation of natural laws of economic importance, should undertake experiments to find out what is the law involved in such cases. I would suggest that the experiments be carried along in at least two parallel lines, one to determine the effect of *nutrition*, the other of *function*.

If rabbits (for example) are chosen for experiment, I would recommend that the beginning be made with a sufficiently large number of animals so that the breeding need not be very close, and that the original stock consist of several breeds (half a dozen or more), their blood to be variously mixed by crossing as the experiments go on, in order that the mongrel produce may have a greater tendency to vary under the conditions imposed than if but one original breed was used whose characters were well fixed and more liable to breed true to the parent type. Let two sets from the same stock be bred separately and the experiments be carried on along two parallel lines; let one set be well fed during growth that the mature animals may be of good and full size, and let the other be stunted during growth by underfeeding. Continue this for a considerable number of successive generations, ten or fifteen at least, the one series being continually well fed, the other continually underfed, and carefully record the results during the progress. Also keep a record of the number of each sex produced, that one phase of the mooted question of the causes of sex may be investigated at the same time.

Inasmuch as the whole increase of the flock could not be kept, in reducing the numbers from time to time great care should be used that selection as to size be not practiced; average animals should be selected by weighing or in some other satisfactory way.

The outcome of such a series of experiments would be of vast importance ultimately in determining the natural laws which underlie the best treatment for growing animals intended for breeding.

For determining the influence of the exercise or disuse of function, another series is requisite. Function may be impaired by disuse, by injury or mutilation; by disease, or by other causes. The most convenient and for various reasons the best way would be to impair function by mutilation. Suppose we use rabbits (as in the previously suggested experiments), beginning with a considerable number of breeds and crossing them until we have a mongrel stock of the different breeds variously intermingled. Let us from the beginning amputate some one limb, soon after birth, of each animal, always amputating the corresponding limb, *e. g.*, the left fore leg or the right hind leg—not the left of one animal and the right of another, but always the correspond-

ing limb. Pursue this for at least ten or fifteen successive generations and record the results. Some other injury might be more convenient, as the extirpation of an eye, inasmuch as there are several recorded cases of alleged transmissions of injury to the eye. If mutilation be objected to, then resort to the more troublesome process of preventing use. Tie up or in some other way prevent the use of one limb or the use of one eye from birth on, and note the effect, if any, on successive generations. While such interference with function is not precisely the reverse of exercise and training (as shown in the development of speed in trotters and milk in cows), yet the laws involved are the same, and would be of great scientific interest as well as of practical importance. It seems to me that experiments on the removal of some organ of little use to the animal in domestication, such as cutting off the tail or an ear, would not fulfill the best condition for experiment. There is too little function involved. A number of other lines of experiment readily suggest themselves, but I have long had this matter in mind, and on the whole the directions I have indicated seem the most practicable, fair, and promising of results. And there can be no complete science of breeding until the fundamental laws are established.

While on this subject I wish to suggest a line of observations to be recorded at those stations where cows are bred and where milk is tested. There is much assertion, but I know of no extensive recorded observations, as to the effect produced by the milking of the dam on the milking capacity of the offspring. Let a record be kept of the successive calves of each cow to see if on the average the earlier calves are as good milkers as the later ones; or if there is any difference, wherein does it lie. Observations on the offspring of any one cow are of little value; recorded observations on many would be of much value in establishing a rule.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY.

E. W. ALLEN, *Editor.*

Laboratory notes, J. L. HILLS (*Vermont Sta. Report for 1891, pp. 55–58*).—*Sampling butter for analysis* (pp. 55, 56).—To ascertain whether butter as worked for the market is sufficiently mixed to admit of a single sample representing it, tests were made in which triplicate and quadruplicate samples of butter from different lots were analyzed. These tests showed that the butters tested were "of very uneven composition, and that several samples from the same butter, all carefully taken, may vary among themselves in per cent of fat more than two butters from different sources."

The Adams method for fat determination (p. 56).—A comparison was made between the Adams method, using fat-free paper and ordinary filter paper corrected for its fat content, and the Beimling centrifugal method. "In twenty-nine out of thirty-two comparisons the unextracted paper with constant subtracted gave higher results, the average being +0.08 per cent. It also gave higher results on the same samples than the Beimling centrifugal method by +0.073. The latter averaged 0.015 higher than the S. & S. fat-free paper."

It has been stated that "after milk has been put on paper the paper yields up more of its substance to absolute ether than it did at first." Investigations at the station have shown that "the addition of a few grains of sodium carbonate to the milk prevents it from having this action on the paper and allows a constant to be obtained and used."

Method of making neutral ammonium citrate and triammonium citrate by direct weight (p. 57).—A method is described for preparing the neutral ammonium citrate used to dissolve reverted phosphoric acid. "The method, though less satisfactory [than Huston's method], was worked out at this station prior to the publication of his work." The method consists in first making triammonium citrate by mixing citric acid and ammonia of known strength in their equivalent proportions, and then adding citric acid until the point of neutrality is reached.

Results of the use of triammonium and strictly neutral ammonium citrates in fertilizer analysis (pp. 57, 58).—A comparison of these two reagents in the case of fourteen different fertilizers showed that on an average the triammonium citrate dissolved 0.23 per cent less than the neutral ammonium citrate, the difference in one case amounting to 1.23

per cent. The only case in which the triammonium citrate dissolved more was with fertilizers containing Redonda phosphate.

"A series of analyses using strictly neutral and slightly alkaline citrates (2 c. c. of 20 per cent ammonia to 100 c. c. citrate) on Redonda phosphate (46.03 per cent total phosphoric acid), averaged 28.21 per cent reverted phosphoric acid using neutral and 41.72 per cent reverted phosphoric acid using the alkaline citrate."

Use of hydrochloric acid in drying silage samples (p. 58).—It is suggested to sprinkle the acid over samples of silage before drying them to insure against loss of nitrogen. Tests made of drying samples with and without this treatment indicated that there may be "a loss of from 2½ to 5 per cent of the total nitrogen present unless acid is used to prevent this di sassociation."

METEOROLOGY.

Climatology of North Carolina, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta., Climatology of North Carolina, pp. 184, maps 4*).—This report includes a brief history of the North Carolina State weather service; a report of the work done during the year 1891; annual meterological summary for 1891; tables of normals for the State; index of meteorological observations made in North Carolina from 1820 to 1891, inclusive; tables of monthly mean temperature and monthly rainfall at stations in North Carolina from 1820 to 1891, inclusive; tornadoes in North Carolina from 1826 to 1892; a brief sketch of the physical geography of North Carolina; and a general sketch of the climate of North Carolina. The meterological summary for 1891 is given in the following table:

Summary of meteorological observations.

	Year 1891.	Normals for twenty years (1872-'91).
Pressure (inches)		
Highest	30.89 (Nov. 19)	
Lowest	29.34 (Nov. 23)	
Mean	30.11	30.08
Temperature (degrees F.):		
Highest	100 (June 17)	
Lowest	3 (Dec. 29)	
Daily range	19.3	
Mean	58.7	59.0
Humidity (per cent):		
Mean	76.8	74.6
Precipitation (inches)		
Total	54.55	53.29
Greatest monthly	20.20 (Feb.)	
Least monthly	0.10 (Oct.)	
Wind:		
Prevailing direction	SW	SW
Maximum velocity (miles per hour)	78	
Weather.		
Clear or partly cloudy days	239	
Cloudy and rainy	126	

The normal climatic conditions for North Carolina have been calculated by combining all the reliable observations from 1872 to 1891, inclusive. The results are given in the following table:

Normals for North Carolina.

	Number of years	Jan.	Feb.	Mar	Apr.	May.	June.
Pressure (inches)	20	30 17	30 13	30. 05	30. 02	30 01	30. 02
Temperature (degrees F)	20	40. 8	44. 3	48. 0	57 7	66 9	71. 4
Mean maximum	9	50. 3	54 8	56 7	69 2	78 3	84 7
Mean minimum	9	33. 9	37. 4	39. 0	48 8	57. 7	65. 6
Daily range	9	16 4	17. 4	17. 7	20 4	20. 6	19 1
Humidity (per cent)	15	76 7	73. 8	70 4	69 4	72 6	74. 5
Rainfall (inches)	20	4 52	4 25	4. 90	3 84	4 20	4 34
Wind direction	18	SW	SW	SW	SW	SW	SW
Hourly velocity (miles)	11	8. 5	9 3	9. 5	8. 8	7 8	7. 0
Number of cloudless days	11	8	8	10	12	10	9
Number of partly cloudy days	11	12	9	11	11	13	14
Number of cloudy days	11	11	11	10	7	8	7
Number of days on which 0 01 inch or more of rain fell	12	14	11	12	10	11	11

	July.	Aug.	Sept	Oct.	Nov.	Dec.	Year.
Pressure (inches)	30 02	30 03	30 08	30 09	30 13	30 16	30. 08
Temperature (degrees F)	77 8	75 8	70 2	59. 7	49. 7	42. 7	59. 0
Mean maximum	87 4	85 2	80 2	70 1	60. 8	54. 0	69 3
Mean minimum	69 0	67 6	62 4	50 6	42. 5	36. 4	50 9
Daily range	18 4	18 6	17 8	19 5	18 3	17 6	18. 4
Humidity (per cent)	75 8	78 6	78. 3	76 2	73 5	74. 7	74. 6
Rainfall (inches)	5 44	6 09	4 65	3 66	3 40	4. 00	53. 29
Wind direction	SW	SW	NE	NE	NE	NE	SW
Hourly velocity (miles)	6. 7	6 6	7. 0	7 5	7. 5	7. 6	7. 8
Number of cloudless days	10	10	11	14	12	11	125
Number of partly cloudy days	14	12	11	9	10	11	137
Number of cloudy days	7	9	8	8	8	9	103
Number of days on which 0 01 inch or more of rain fell	13	13	9	8	8	10	130

The adaptability of the climate of North Carolina to human comfort and physical well-being is evident from the preceding summary. To the diversity of meteorological features corresponds as wide a variety of vegetable products, both natural and cultivated. Plants whose natural habitat is lower Canada, such as the white pine and spruce, are found in the forests of the Blue Ridge, and in the southeastern portion of the State the palmetto and magnolia of semitropical origin. The climatic conditions are favorable to the growth of a great variety of crops, as cotton, corn, tobacco, and small grains, which are the staple crops of the State, as well as almost every kind of fruit and vegetable.

Meteorological summary for August and September, 1892 (*Massachusetts State Sta. Bul. No. 44, Oct., 1892, p. 1*).—A general summary of observations, with brief notes on the weather.

Meteorological observations, C. D. WARNER (*Massachusetts Hatch Sta. Meteorological Bul. No. 46, Oct., 1892, pp. 4*).—A daily and monthly summary for October, 1892, of observations at the meteorological observatory of the station.

WATER—SOILS.

W. H. BEAL, *Editor*.

Analyses of drinking water, J. L. HILLS (*Vermont Sta. Report for 1891, p. 47*).—Tabulated analyses of 35 samples of well, spring, pond, and lake water from different localities in Vermont.

The soils of Oregon, G. W. SHAW (*Oregon Sta. Bul. No. 21, Oct., 1892, pp. 20*).—Discussions of the need of soil investigations, relation of geology to agriculture, origin of soils, classification of soils, and topography and geology of the State are accompanied by mechanical and chemical analyses and descriptions of nineteen representative soils of the bottom, hill, tide, and beach lands of western Oregon, principally of the Willamette Valley, and two soils of eastern Oregon.

The work reported was done in pursuance of a plan to make a complete agricultural and mineral survey of the State, but has not yet advanced far enough to admit of definite conclusions being drawn.

The State, comprising an area of 96,000 square miles, lies between 117° and 125° west longitude and 42° and 46° north latitude. It is naturally divided into eastern and western Oregon by the Cascade Mountains. The eastern portion is about 3,000 feet above the level of the sea and embraces about two thirds of the State. That part of the State, together with a part of Washington, often goes by the name of the "Inland Empire" since it is so surrounded by various mountain systems. The western portion may well be divided into a northern and southern portion, the first of which comprises the great Willamette Valley and a portion of the coast mountains. Throughout the entire western portion of the State there is a multitude of small streams, furnishing an ample flow of water during the entire season. The Willamette Valley, embracing about 5,000,000 acres, is by far the largest valley in the State. It is about 130 miles in length by 60 in width, and extends from a low range of hills on the south (Calipooias) to Portland on the north. To show how well watered is this valley it may be stated that over forty streams feed the Willamette in its course, and the stream is navigable for about 100 miles from its mouth.

The soils of the valley may be classified under two general heads, viz, those of the foothills and those of the bottom lands extending along each bank of the river. The former comprise a belt of rolling land extending nearly around the prairie and merging into the mountains. The prevailing soils are of basaltic origin mixed with more or less sandstone soil on the west side. The purely basaltic soils are mostly confined to the hilltops where they are generated. All the "bottom land" is of an alluvial nature and varies greatly in depth, from a few inches to many feet. It is made up of the washings from the hills, and consists, as one would infer from the above, of a decomposed volcanic substance, somewhat basaltic in nature, mixed with sand and a large amount of alluvial deposit and vegetable mold or "humus," the last-named substance being the more abundant in this portion of the State because of the larger rainfall. * * *

As we pass into the southern division of western Oregon Mesozoic strata are prominent. * * * As the rocks, so the soils here are quite varied, and it is not uncommon to find a half dozen different soils on 160 acres. The predominating soil of this portion seems to be a red clay, which terminates in the high plateaus. Black loams, with vegetable débris, are found along the principal valleys, where granitic soil is not uncommon.

FERTILIZERS.

W. H. BEAL, *Editor.*

Analyses of fertilizers, E. B. VOORHEES (*New Jersey Stas. Bul. No. 89, Oct. 10, 1892, pp. 40*).—Tables give the analyses and valuation of 248 samples of fertilizing materials, including compound fertilizers, ground bone, dissolved bone, soot, wool waste, wood ashes, muck, ashes, and marl.

The average composition, selling price, and commercial valuation of complete fertilizers for 1891 and 1892 are given in the following tabulation:

Years.	Total nitrogen.	Total phosphoric acid.	Available phosphoric acid.	Insoluble phosphoric acid.	Potash.	Selling price.	Station valuation.
1891	2.71	10.12	7.29	2.83	4.21	$34.23	$25.31
1892	2.74	10.38	7.70	2.67	4.50	34.19	25.66

The average selling price is practically identical with that of last year, while the gain in quality is more than sufficient to offset any decrease due to the use of the lower values. * * *

This year the average selling price per ton [of ground bone] is $31.35, and the station's valuations $33.78. In 1891 the average selling price was $31.99 and the station's valuations $31.97. A decided gain is observed in both directions, viz, an increase in valuation of $1.81 per ton and a decrease in average selling price of 84 cents per ton. Last year the cost per pound of the nitrogen and phosphoric acid in the different grades was practically identical with the station's schedule of prices; this year the cost is about 8 per cent lower than the schedule. * * The results of the analyses of dissolved bone are in accord with those secured in previous years, viz, that these products furnish readily available forms of nitrogen and phosphoric acid at much cheaper rates than the majority of complete fertilizers.

Fertilizer inspection in Rhode Island, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Bul. No. 19, Sept., 1892, pp. 61-70*).—Analyses of 41 samples of fertilizing materials, including compound fertilizers, wood ashes, muriate of potash, and nitrate of soda, together with comments on the compliance with guaranties in 1891 and 1892. The figures show an improvement in this regard during 1892.

Analyses of licensed fertilizers (*Vermont Sta. Report for 1891, pp. 35-37*).—An abstract of Bulletin No. 23 of the station (E. S. R., vol. II, p. 744).

Analyses of miscellaneous fertilizers, J. L. HILLS (*Vermont Sta. Report for 1891, pp. 45, 46*).—Tabulated analyses of muck, wood ashes, limekiln ashes, bone meal, tankage, muriate of potash, and compound fertilizers.

FIELD CROPS.

A. C. TRUE, *Editor.*

The relation of number of eyes on the seed tubers of potatoes to the product, J. C. ARTHUR (*Indiana Sta. Bul. No. 42, Nov., 1892, pp. 105–118, figs. 4*).

Synopsis.—Selected data from experiments during three years are given, showing the number of stalks per eye produced from cuttings having from one to four eyes, and from whole tubers; the number of stalks as related to the weight of the seed materials in cuttings and whole tubers; the effect of bisecting the eyes on the number of stalks produced; and the relation of the number of stalks per hill to the yield. In general it appears that within certain limits the yield will increase with an increase in the weight of the cuttings used for seed, and that the exact number of eyes per cutting is relatively unimportant. Bisecting the eyes is likely to increase rather than diminish the number of stalks.

Experiments with reference to the relation of the number of eyes on the seed tuber of potatoes to the product have been conducted at the station during the past three years on the following plan:

From a very large supply of seed material only perfect tubers of uniform shape [are selected]. These are assorted according to weight. For each grade a variation of ½ ounce is allowed; thus all tubers ranging between ¾ ounce and 1¼ ounces are put into the 1-ounce grade; all between 1¼ and 1¾ ounces into the 1½-ounce grade; all between 1¾ and 2¼ ounces into the 2-ounce grade, and so on up to the largest tubers obtainable. When pieces of tubers are used as seed material they are taken only from the central part of the tuber unless otherwise specified, and are trimmed carefully until brought to the exact weight desired. In order to secure as uniform conditions of growth as possible, the planting is done in hills 3 feet apart each way unless otherwise specified. The record of the appearance of the first stalk above the ground, of the number of stalks, and of the yield is kept for each hill separately.

From the mass of data collected the materials for this bulletin have been selected. In the following table is given the number of stalks per eye produced when the seed tubers are cut into pieces weighing 40 grams (about 1½ ounces) each:

Number of stalks compared with number of eyes, cut tubers.

Date of planting.	Variety.	Weight of parent tuber.	Number of pieces.	Weight of piece.	Number of eyes per piece.	Stalks per piece.	Stalks per eye.
		Ounces.		*Grams.*			
Apr. 18	Burbank	2	40	40	1	4.2	4.2
Apr. 18	......do	2	40	40	2	5.1	2.6
Apr. 18	......do	2	40	40	3	5.0	1.7
June 25	Beauty of Hebron	3	16	20	2	2.7	1.4
June 25	......do	3	16	20	3	3.1	1.0
June 25	......do	3	16	20	4	3.2	0.8
June 25	......do	7	16	40	1	2.2	2.2
June 25	......do	7	16	40	2	2.3	1.2
June 25	......do	7	16	40	3	4.4	1.5
June 25	......do	7	16	40	4	5.1	1.3
June 25	Burbank	7	16	40	1	2.1	2.1
June 25	......do	7	16	40	2	2.6	1.3
June 25	......do	7	16	40	3	3.5	1.2
June 25	......do	7	16	40	4	4.6	1.2

This gives for 1, 2, 3, and 4-eye pieces, cut to a uniform weight of 40 grams, an average of 3.29, 2, 1.54, and 1.25 stalks to the eye, respectively, being 3.3, 4, 4.6, and 5 stalks per piece. This makes it apparent that when the weight of the pieces remains constant the number of stalks per eye rapidly decreases the more eyes the piece contains, and at the same time the number of stalks per piece somewhat increases.

[Keeping the number of eyes constant, we find that] two pieces (80 grams) with one eye each will give nearly as many stalks as one piece (40 grams) with two eyes; that three pieces (120 grams) with one eye each will give about twice as many stalks as one piece (40 grams) with three eyes; and that four pieces (160 grams) with one eye each will give not much more than twice as many stalks as one piece (40 grams) with four eyes. From this it appears that increasing the number of pieces and thereby increasing the total weight of the seed material increases the number of stalks for any certain number of eyes, but not in the same proportion. We may look at the matter in quite another way by comparing undivided pieces with the same number of eyes but of different weights. Thus 40-gram pieces give more stalks to the piece than 20-gram pieces having the same number of eyes; but the limited data makes close comparison impossible. * * *

Now as pieces of uniform weight give but a small increase in the number of stalks by increasing the number of eyes to a piece, and as the increase in weight of the pieces will in itself cause a decided increase in the number of stalks, it is apparent that when pieces increase both in weight and in number of eyes at the same time the weight of the piece will be the more important factor.

When whole tubers were used for seed the results were as indicated in the following table:

Number of stalks compared with number of eyes, whole tubers.

Date of planting.	Variety.	Number of tubers.	Average weight of tubers.		Number of eyes per piece.	Average number of stalks per piece.	General average of stalks per tuber.
			Oz.	*Grams.*			
May 2, 1891	Burbank	10	1½	43	8	5.5	
Do	do	6	1½	43	9	5.3	5.5
Do	do	11	1½	43	10	5.6	
May 23, 1892	do	5	2½	71	10	5.8	
Do	do	6	2½	71	11	5.0	
Do	do	8	2½	71	12	6.9	
Do	do	8	2½	71	13	5.6	
Do	do	5	2½	71	17	5.8	5.7
Do	do	8	2½	71	18	5.1	
Do	do	8	2½	71	19	5.8	
Do	do	6	2½	71	20	5.8	
June 25, 1892	do	8	3	85	14	10.8	
Do	do	8	3	85	15	10.5	
Do	do	8	3	85	16	11.5	11.3
Do	do	8	3	85	17	11.9	
Do	do	8	3	85	18	11.7	
Do	Beauty of Hebron	8	3	85	11	9.9	
Do	do	8	3	85	13	10.8	
Do	do	8	3	85	15	10.5	10.0
Do	do	8	3	85	17	8.6	

This table brings out the fact very strikingly that when the tubers are of the same variety and weight the number of shoots does not perceptibly increase with the increase of eyes on the tuber. This is probably not in anywise due to the fact that the pieces are uncut tubers, but chiefly to the comparatively small amount of nutriment available for each eye. * * *

One apparent discrepancy requires a word of comment. The number of stalks from 71-gram tubers is but slightly larger than the number from 43-gram tubers, while from 85-gram tubers the number is about twice as great. This irregularity is doubtless due to the influence of temperature, moisture, or some such factor introduced by conducting the experiments upon different dates. How much influence these factors may exert can not be estimated, as no exact data are available.

The far greater importance of the weight of the seed material than of the number of eyes present in determining the number of shoots, has now been made evident. Further data may now be brought forward to show that in practice the particular number of eyes upon a piece is of slight moment, while the weight is highly important.

If seed material is cut into pieces of definite weight, without regard to the number of eyes, of course assuming that each piece is not wholly without eyes, definite relations will be found to exist between the weight of the piece planted and the number of stalks it gives rise to.

Number of stalks compared with weight of seed material, cut tubers.

Date of planting.	Variety.	Weight of parent tuber.	Number of pieces.	Weight of piece.	Stalks per piece.
		Ounces.		*Grams.*	
Apr. 19, 1890	White Star	(?)	80	20	2.0
Apr. 30, 1890	Burbank	2½	20	20	1.8
Do	....do	4	40	20	1.6
Do	....do	6	77	20	1.9
Do	....do	8½	106	20	1.8
Apr. 23, 1891	....do	3½	40	20	4.0
Do	....do	3⅓	40	40	4.9
Do	....do	3½	40	60	6.0
Do	....do	3½	40	80	7.3
Do	....do	3½	40	100	7.2
Apr. 28, 1891	....do	3½	40	60	6.1
Apr. 30, 1892	....do	3	39	60	5.6

These data show that pieces of the same weight give approximately the same number of shoots, even when cut from different-sized tubers, while pieces increasing in weight in a regular series from 20 to 100 grams give an increasing number of shoots. A still further inspection will show that the increase in the number of shoots does not keep pace with the increase in the weight of the piece, which is essentially what was found in the case of pieces cut to eyes.

Number of stalks compared with weight of seed material, whole tubers.

Date of planting.	Variety.	Number of tubers.	Average weight of tubers.	Average number of stalks per tuber.
			Ounces.	
May 3, 1890	Burbank	40	1½	4.2
Do	....do	40	3¾	8.0
Do	....do	40	4¾	8.8
Apr. 20, 1891	....do	40	1	2.9
Do	....do	40	1½	4.6
Do	....do	40	2	5.3
Do	....do	40	3	6.9
Do	....do	20	4	6.2
Do	....do	20	5	6.4
May 23, 1892	Beauty of Hebron	40	2	4.9
Do	....do	40	2½	5.7
Do	....do	40	3	6.3
Do	....do	40	3½	7.0
Do	....do	40	4	7.6
Do	....do	40	4½	8.5
Do	....do	40	5	8.9
Do	....do	40	5½	9.4

[These figures indicate that] the heavier the tuber the more shoots it will send out. Further inspection will show that the same law of restricted increase holds true as in the case of cut tubers. The law may be stated as follows: A series of tubers or pieces of tubers increasing in weight by a constant arithmetical difference, will give rise to shoots whose numbers form a series the terms of which bear a decreasing ratio to the corresponding terms of the first-named series.

The data thus far given go to show that in cutting seed potatoes the weight of the piece is the only thing which needs to be considered. To answer the objection that by cutting pieces of equal weight some of the eyes would be cut in two and thus destroyed, the following experiment is cited:

Pieces were cut to weigh 20 grams each, half the number containing one eye to the piece and half containing two eyes; another set was prepared in the same manner, except that the pieces were cut to weigh 40 grams each. Half the pieces containing one eye to the piece and also half containing two eyes were then cut in two so as to divide each eye through the middle, and the whole number planted in the open ground.

Effect of bisecting the eyes of a potato tuber.

Date of trial.	Variety.	Weight of piece.	Number of eyes per piece.	Number that grew.		Average number of stalks per piece.	
				Eyes whole, 16 pieces.	Eyes bisected, 8 pieces	Eyes whole.	Eyes bisected.
		Grams.					
June 25, 1892	Burbank	20	1	11	7	1.3	2 0
Do	do	20	2	16	7	2.7	4.0
Do	do	40	1	16	6	2 2	2 7
Do	do	40	2	16	7	2.3	3.7

Not only did most of the pieces with bisected eyes grow, but they produced in every instance more shoots than those with eyes undisturbed. This apparently augmented growth is undoubtedly due to the fact, which has already been pointed out, that increasing the number of pieces planted also increases the number of stalks, but in a diminished ratio. * * *

Each half of a bisected eye produced nearly as many stalks as each whole eye. This need not seem odd if it is remembered that the potato eye is in reality made up of a group of buds, only one or two of which usually grow, and that cutting through this group would most likely leave uninjured buds upon each piece in viable condition.

The relation between the number of stalks and the yield is shown in the following summary of an experiment:

Number of stalks per hill compared with the yield.

Variety.	Size of tuber planted.	Average number of stalks per hill.	Average number of tubers per hill			Average weight of tubers per hill.			Yield per acre.		
			All sizes.	Small.	Large.	All sizes.	Small.	Large.	All sizes.	Small.	Large.
	Oz.					*Gr.*	*Gr.*	*Gr.*	*Bush.*	*Bush.*	*Bush.*
Burbank	1	4.3	5.8	4.5	1.3	212	90	122	38	16	22
Do	1½	4.9	7.9	5.2	2.7	374	125	249	67	23	44
Do	2	6.5	9.6	6.1	3.5	467	156	311	83	28	55
Do	2½	6.7	11.6	7.9	3.7	518	201	317	92	36	56
Do	3	7.9	12.6	8.2	4.4	635	212	423	113	38	75
Do	3½	8.4	15.2	10.2	5.0	673	188	485	120	34	86
Do	4	9.5	17.3	10.4	6.9	915	273	642	163	49	114
Do	4½	9.6	18.4	11.2	7.2	967	282	685	172	50	122
Do	5	11.0	19.4	12.2	7.2	983	309	674	175	55	120
Beauty of Hebron	2	4.9	15.1	8.3	6.8	883	209	674	157	37	120
Do	2½	5.7	16.9	9.8	7.1	953	235	718	169	41	128
Do	3	6.3	18 6	10.9	7.7	1,015	278	737	181	50	131
Do	3½	7.0	18.2	10.4	7.8	1,072	289	783	191	52	139
Do	4	7 6	20.4	11.8	8.6	1,213	323	890	216	58	158
Do	4½	8.5	21.6	12.4	9.2	1,282	364	918	228	65	163
Do	5	8 9	22.4	13.8	8.6	1,265	383	882	225	68	157

There is a uniform increase in the average number of stalks per hill to correspond with the increased size of the seed tuber used. With the increase of the number of stalks per hill there is also a practically uniform increase in the weight of the product, whether considered as total yield or separated into small and large tubers. * * *

We have therefore finally arrived at the conclusion that the weight of the piece is, in comparison with the number of eyes, the all-important factor in preparing seed material, and that within certain limits heavier pieces give larger yields.

Ensiling turnips (*Vermont Sta. Report for 1891, p. 88*).—A trial of ensiling turnips resulted disastrously.

Effect of fertilizers on the composition of crops, J. L. HILLS (*Vermont Sta. Report for 1891, pp. 50–54*).—For three successive years corn, peas and oats, and rye have been grown on 16 differently fertilized plats, and analyses made of the crop to determine the amount of fertilizing ingredients removed by the crop on different plats. The results for the three years as summarized in two tables "seem to indicate that phosphoric acid was most needed on this soil and with these crops, and that it lasted longer and gave better returns than the other ingredients. The soluble forms on the whole did better, but similar money value in the insoluble forms might have done as well."

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Alfalfa root rot, G. W. CURTIS (*Texas Sta. Bul. No. 22, Sept., 1892, pp. 211–215*).—The cause of this disease is said to be the same as that of the "root rot of cotton," which was described under the name *Ozonium auricomum* in Bulletin No. 7 of the Texas Station (E. S. R., vol. I, p. 318). In the field the disease spreads from a center in an almost perfect circle at a rate of 50 or 60 feet per season, completely killing all plants in such an area. Plowing around such patches, even at quite a distance from where the disease is manifest, had no effect in checking its spread. During the cool season the dying of the plants ceases, to begin again upon the return of hot, dry weather. An examination of the roots shows that the fungus first attacks the crown and works downward to a depth of from 6 to 10 inches, beyond which the roots seem unaffected. The identification of the fungus was made by G. F. Atkinson. He says: "I am absolutely certain that one of the fungi which I find in the alfalfa roots sent me is identical with the *Ozonium auricomum*, described in the Annual Report of Texas Station for 1889 [also in Bulletin No. 7]. * * * Besides this I have found two other fungi, one a saprophytic mucor, which probably has nothing to do with the disease, the other an exceedingly active parasite, which I have recently separated from young cotton plants which had rotted off at the crown." Sowing salt plentifully in cotton fields seems to have lessened the loss from root rot and the same agent is to be tried on alfalfa.

Kerosene will also be tried. It is expected that the alfalfa may be killed where this fungicide is used, but that the progress of the disease will also be stopped.

Report of botanist of Vermont Station, L. R. JONES (*Vermont Sta. Report for 1891, pp. 128–143*).—The subjects reported upon are, (1) use of Bordeaux mixture in potato rot and potato blight, (2) comparative tests of fungicides for potato blight, (3) a new potato disease, (4) treatment for apple and pear scab, (5) apple rust and cedar apples, (6) a spot disease of Baldwin apples, (7) brown rot of plums, (8) oat smut, (9) effect of various fungicides upon seed corn, (10) lettuce mildew and rot, (11) Vermont weeds. The notes on the potato blight and rot, a new potato disease, apple and pear scab, and oat smut are continuations or abridgments of articles in Bulletin No. 28 of the station (E. S. R., vol. III, p. 891). In the comparative tests of fungicides for potato blight and rot, four formulas were used, (1) the standard Bordeaux mixture; (2) a weaker Bordeaux mixture, containing 33 gallons of water instead of 22; (3) ammoniacal copper carbonate; and (4) a glue mixture, the formula of which is sodium carbonate 12 ounces, copper sulphate 10 ounces, liquid glue 8 ounces, and water 45 gallons. The fungicides were used in five potato fields. Through a misunderstanding only those potatoes dug from the vines treated with the full-strength Bordeaux mixture were measured for comparison, and the increase was 26 per cent over the yield in the untreated rows. Both the ammoniacal copper carbonate and the glue mixture injured the leaves to a considerable degree. The experiment with apple rust as caused by cedar apples is in the same line as that mentioned in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 479).

A spot disease of the Baldwin apple, which has become quite common throughout the State, is mentioned. The apples showed sunken spots the size of a pea or larger.

> The flesh underneath the spot showed brown discoloration for $\frac{1}{8}$ inch or more in depth, and this discolored portion was quite bitter to the taste. Specimens of the diseased apples placed in a moist chamber soon developed small grayish pustules at or near the center of the spot, the pustule being from $\frac{1}{16}$ to $\frac{1}{8}$ inch in diameter. Microscopic examination of these pustules showed their fungous nature, and their general occurrence upon the center of the brown spots indicated a direct causal connection of the fungus with the spot.
>
> Mr. J. B. Ellis, of Newfield, New Jersey, identified the fungus as being probably *Dothidea pomigena*, Schn.

Owing to a lack of material the study of the fungus was not completed, but will be continued another year. Inquiry fails to find any notice of this disease except on the variety from which it receives its name.

A description of the brown rot of plums, caused by *Monilia fructigena*, is given, together with an account of the method by which the spores are carried over the winter and suggestions as to remedial treatment. Details of experiments made with oats treated for smut are

given. They were carried on during the past season on the plan set forth in Bulletin No. 28, referred to above.

The effect of several fungicides on the vitality of seed corn is given. Treatment of 2 varieties of corn with water heated to from 100° to 150° F. was attempted, with the following result: One variety of low vitality was injured by treating it with water heated above 120°; below that temperature the treatment seemed beneficial; with the other variety no perceptible effect, even for the highest temperature, was noted. Soaking the seed in Bordeaux mixture was somewhat beneficial. Soaking for fifteen minutes in copper-sulphate solutions had no effect. If this treatment was continued for an hour or longer the seed was injured.

Mention is made of the occurrence of lettuce mildew (*Peronospora gangliformis*) and lettuce rot (*Botrytis vulgaris*) in the greenhouse of the station. Fumigation with sulphur removed every trace of the former. The rot was much worse upon some varieties than upon others, the "head" varieties being the only ones attacked.

A list of forty-two of the weeds of Vermont is given, of which the following may be considered as the "worst weeds:" Quack grass (*Agropyrum repens*), white daisy (*Chrysanthemum Leucanthemum*), charlock (*Brassica* spp.), live-forever (*Antennaria plantaginifolia*), hawkweed (*Hieraceum aurantiacum*), lance-leaved plantain (*Plantago lanceolata*), wild carrot (*Daucus carota*), brake (*Osmunda cinnamomea*), yellow dock (*Rumex crispus*), and Canada thistle (*Cnicus arvensis*).

ENTOMOLOGY.

The pear tree psylla, M. V. SLINGERLAND (*New York Cornell Sta. Bul. No. 44, Oct., 1892, pp. 161–186, figs. 8*).

Synopsis.—A report of studies and observations on the pear tree psylla (*Psylla pyricola*) by the author under the following heads: Past history; classification; indications of presence; appearance and life history, including a detailed account of a single generation from breeding-cage experiments; methods of repression; technical descriptions of nymph and adult forms; and bibliography and synonyms. A shorter account of these investigations was published in the proceedings of the Association of Economic Entomologists in Insect Life, vol. V, pp. 100–103.

The pear tree psylla was introduced into Connecticut from Europe in 1832, and has been quite widely distributed over the northeastern portion of the United States as far west as the Mississippi Valley. In 1891 it did great damage to pear orchards in certain localities in New York and New England. Trees attacked by this insect show a weakened vitality early in the season. The new growth is restricted and soon begins to wither. The leaves turn yellow and by midsummer very many of the leaves and half-formed fruits have fallen to the ground. Immense quantities of a sweet fluid called honeydew cover the twigs, branches, and trunks of the trees. This honeydew is at first clear, but is soon filled with a black fungus (*Fumago salicina*).

The following summary is taken from the article in Insect Life above referred to:

The adult insect measures scarcely 3 mm. in length, is very active, and strikingly resembles a cicada in miniature. The nymphs are oval, exceedingly flat, of a light yellowish color when young, but becoming blackish, with distinct markings when full-grown The light yellowish cylindrical-ovate eggs, which are scarcely visible to the unaided eye, are attached by a short stalk near the larger end and have a long, slender thread projecting from the smaller end.

My observations upon this pest began in December, 1891. At that time adults and a few nymphs were found hidden in the crevices of the bark of the pear trees; no eggs were found. The hibernating adults were watched and the trees carefully examined at various times during the winter, but no eggs were laid until about April 10, when the adults were frequently seen in copulation. These eggs were laid in the creases of the younger branches about the bases of terminal buds. Eggs on branches brought into the insectary at this time hatched in eleven days, but in the field the nymphs did not emerge until about May 10, when the leaves had begun to unfold. The minute creatures immediately crawled as far as possible into the leaf axils and began sucking the sap. This seems to be the favorite point of attack through the season, and nymphs are invariably found in the leaf axils or on the stems of the fruit, unless very numerous, when they cluster about the branches just below the leaves or along the midrib of the leaves. They prefer the younger and tenderer branches and leaves, which often droop early in the season from the excessive loss of sap occasioned.

By careful observations upon isolated individuals I have found that the nymphs molt five times, including the one at which the adult insect appears.

Adults of the first spring brood began to appear about June 1. For two days after emerging they were of a greenish color and then took on the characteristic red and black markings. Eggs from these adults were plentiful about June 15 and were found on the under side of the younger leaves, usually partially hidden in the pubescence along each side of the midrib. Adults of this second brood appeared in about thirty days, or July 15. There will thus be at least three and probably four broods during the season. During the summer all stages of the insect may be found on the trees, owing to the overlapping of the broods.

The summer forms of the adults are smaller and less intense in coloring than the hibernating adults. In the former the front wings are of a yellowish tinge, and the veins, even in dark specimens, are light yellow, while the front wings of the latter are nearly transparent, with dark shades in the cells and very dark brown or black veins. After a careful comparison of both forms with the descriptions of the four known pear psyllas, *pyri, pyricola, pyrisuga,* and *simulans*, I am led to believe that the insect in question is *Psylla pyricola*, and that *Psylla simulans* is the winter variety or hibernating form of *pyricola*.

Last year the nymphs were so numerous by June 15 that the honeydew secreted covered the branches and trunks of the trees, and was accompanied by the usual black fungus, which gave the trees a very smoky, unhealthy appearance. The honeydew appears to be secreted only by the nymphs, but in what manner I do not know. The excrement and honeydew are distinct, the former having a firm, whitish appearance, while the latter is clear like water. I think both secretions come from the anus.

With a view to finding an effective means of destroying this pest, eggs were dipped into kerosene emulsion (full strength and diluted with three parts of water heated to 130° F.), undiluted kerosene, turpentine emulsion (diluted with three parts of water), undiluted turpentine, crude carbolic acid emulsion (diluted with ten parts of water), resin wash

(triple strength and heated to 130° F.), whale-oil soap (double strength), sulphate of potash wash (double strength), concentrated potash (1 pound to 1 gallon of water), and undiluted benzine. In all cases the eggs hatched a few days after treatment.

Nymphs dipped in kerosene emulsion were killed even when the emulsion was diluted with twenty-five parts of water. Spraying experiments with the kerosene emulsion were also successful.

By carefully examining the trees before and soon after spraying, it was estimated that from 75 to 90 per cent of the nymphs were killed by one spraying with kerosene emulsion diluted with twenty-five parts of water. Some of the nymphs had by this time become nearly full grown, but these were as quickly and effectually destroyed as were the young ones. The habit of the nymphs of feeding in the leaf axils made it easier for the spray to reach them; the liquid would naturally run down the leaf petioles and twigs and gather in the axils, and thus become very effective. It was found that 2 quarts of the dilution was sufficient for a large dwarf tree; and thirteen such trees could easily be sprayed in half an hour with a knapsack sprayer. It would of course take more time and material to spray the large standard trees, but the whole cost for each tree would not be more than 1 cent a tree for time and material. * * *

The honeydew did not interfere with the action of the insecticide this year—1892. This was probably due to the fact that many hard showers fell during the early part of the season. The rain washed off much of the secretion. This fact should be taken advantage of by fruit growers in spraying for the pest. Spray soon after a heavy rain storm if possible; a shower soon after spraying will not lessen the destructiveness of the emulsion as the nymphs are killed almost instantly. * *

The best time to spray is early in the spring just after the leaves have expanded. In 1892 about May 15 was the best time. Then this first brood of nymphs had all emerged and were exposed in the axils. It was this first brood that did the most damage in 1891. Therefore it is very important that the insect should be checked early in the season.

The white grub, G. H. PERKINS (*Vermont Sta. Report for 1891, pp. 144–155*).—Accounts of observations by the author on the life history of species of *Lachnosterna* prevalent in Vermont, and notes on experiments for their repression.

Until recently all writers have declared that the *Lachnosterna* larvæ, the white grubs, complete their growth in the spring or early summer and then in a short time change to beetles. Our observations show very conclusively that this is not true, but that the larvæ get their full growth during the early summer, enter the chrysalid state, and emerge as perfect beetles late in the summer or early in the fall. They remain more or less dormant during the winter in the ground, a few coming from the ground in the fall, but most not until the following spring. The eggs are laid in spring and the beetles die in early summer.

Mites, thought to be of the genus *Tyroglyphus* or *Rhizoglyphus*, were observed on the legs of larvæ dug from the ground early in March. The fungus *Cordyceps ravenelii* was on larvæ dug April 2. Larvæ of three sizes were found in the ground at the same time.

Altogether several hundred larvæ were collected and placed in boxes, where they could be watched. They continued in excellent condition throughout the summer, but, with two exceptions, showed no indication of pupation until September. These two made cells and pupated early in May. The rest were all changed to beetles by the last of September. There was no appreciable change in size or appearance of

the large larvæ during the summer, although as they were supplied with turf they did not lack food. * * *

The first beetles appear usually about the first of May, but unless the season is unusually early they are not at all abundant until the middle of May or even later. After the middle of May the numbers increase until after the first of June, when usually there is a decrease. Few are seen after the last of June until the new brood makes its appearance as a few stragglers in September, October, or even November. These last probably all perish from cold; some certainly do.

The common species here are *Lachnosterna dubia*, Smith, and *L. fusca*, Froh. Very much less common are *L. grandis*, Smith, *L. arcuata*, Smith, *L. insperata*, Smith, and *L. rugosa*, Mels. Usually more males than females were taken.

Larvæ kept for a week in frozen ground in January were killed. Other similar experiments gave the same results. "Yet some of the grubs dug from frozen ground in March were, to all appearances, not injured."

Grubs kept for weeks in sand almost entirely free from vegetable matter were not starved. Dryness of the soil injures the grubs and if long continued destroys them. Potash salts were not especially injurious to the grubs unless used in large quantities. Salt and wood ashes were unsuccessfully used as insecticides for these grubs. Bisulphide of carbon and kerosene emulsion were effective. Ants, frogs, raccoons, and other enemies of the grub are mentioned.

Notes on insecticides, G. H. PERKINS (*Vermont Sta. Report for 1891, pp. 155–159*).—Brief notes on the author's experience with Paris green, kerosene emulsion, and potash salts. Naphthaline has been found to be an efficient repellent of moths, while pyrethrum and cedar chips were of no use for this purpose.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor*.

Analyses of maple sugar and feeding stuffs, J. L. HILLS (*Vermont Sta. Report for 1891, pp. 18, 19*).—Results of the determination of sugar in 61 samples of maple sugar, and analyses of the following feeding stuffs: Hay from tall fescue, redtop, alfalfa, orchard grass, Rhode Island bent grass, fowl meadow oat grass, fowl meadow grass, timothy, green barley, damaged corn meal, mixed meal, corn germ feed, cream gluten feed, and animal meal. The percentage of sugar in the different samples of maple sugar ranged from 70 (very wet) to 99.5 (white granulated crystal).

Experiments in feeding steers, C. C. GEORGESON, F. C. BURTIS, and W. SHELTON (*Kansas Sta. Bul. No. 31, Sept., 1892, pp. 51–98, plates 8*).

Synopsis.—A comparison on four lots of five steers each of stall-feeding and feeding in the yard in winter, of whole corn and corn meal, and of corn meal and a rich nitrogenous grain mixture. After six months' feeding the animals were sold and slaughtered. All were fed at a financial loss. The lot fed the nitrogenous ration were pronounced in much the best condition and produced gain at relatively the lowest cost for food. The results were in favor of stall-feeding, and

indicate that the expense of fattening may be considerably increased by outdoor feeding in winter. The results as to the relative value of whole corn and corn meal were inconclusive. The experiment calls attention to the losses which may result from feeding steers beyond a certain weight, showing that beyond a certain point the amount of food required per pound of gain in weight increased considerably.

The questions for which answers were sought in this experiment were: "Is the exclusive corn diet, which is well-nigh universal in these States, the cheapest way of finishing beeves for market? Is there anything gained by sheltering fattening beeves? Do we get better returns from corn meal than from whole corn?" Twenty grade Shorthorn steers, three-year-olds, selected from a herd of nearly two hundred, were divided into four lots of five animals each. Two lots were fed on whole corn, corn fodder, and prairie hay, one lot being confined in the barn and the other in an open yard containing a shed open on the south side. The other two lots were fed in the barn, one receiving corn meal, corn fodder, and prairie hay, and the other a mixture of corn meal, linseed meal, bran, shorts, corn fodder, and prairie hay. The feeding lasted from November 30 to May 30. The amount of food given was regulated by the appetite of each animal. The nutritive ratios of the rations of the several lots were as follows: Mixed-grain ration 1: 6.27 to 1: 5.92, corn-meal ration 1: 11.16, whole-corn ration 1: 12.06 to 1: 12.87. The average weight of the steers at the beginning of the trial was 1,200 pounds, and the average cost $3.29 per 100 pounds live weight. The steers were weighed separately each week.

At the conclusion of the trial the steers were sold to the Armour Packing Company at Kansas City, and data were secured as to the dressed weight and intestinal fat in the case of each steer. The lot fed mixed grain were sold at $4.20 and the other lots at $4.10 per hundred weight. Summaries are tabulated for each steer of the food eaten, fluctuations in live weight, cost of food, water drank, dressed weight, shrinkage in dressing, and intestinal fat; and the financial result is given for each lot. The cost of food is based on ear corn at 47 cents, corn meal at 55 cents, shorts at 54 cents, bran at 40 cents, linseed meal at $1.35, tame hay at 25 cents, cornstalks at 12½ cents, and prairie hay at 17½ cents per 100 pounds.

A condensed summary of the results follows:

Summary of results of feeding trial with steers.

	Average gain in live weight.	Food consumed per pound of gain.		Total cost of food per lot.	Selling price per lot.
		Grain.	Coarse fodder.		
	Pounds.	*Pounds.*	*Pounds.*		
Lot 1, mixed-grain ration	435.6	10.0	3.2	$155.00	$341.46
Lot 2, corn-meal ration	268.0	13.3	3.5	105.56	299.30
Lot 3, whole-corn ration, in barn	284.2	14.1	4.7	104.27	300.53
Lot 4, whole corn ration, in yard	312.8	15.3	2.8	126.01	300.53

In the financial statement no account is taken of the cost of feeding or the value of the manure. All four lots were fed at a financial loss, this loss ranging with the different lots from $15.48 with lot 3 to $37.21 with lot 4.

"The showing on the block was decidedly in favor of lot 1 [mixed grain ration]. Several good judges of meat, who examined and compared the carcasses after slaughtering, had no great difficulty in picking out the best fed lot. Aside from being the heaviest, the meat was thicker and the fat more abundant and better distributed. The carcasses of the other three lots did not differ in appearance to any marked degree, but the figures show some difference in favor of those fed indoors."

The food nutrients consumed per pound of gain are stated as follows:

Food nutrients per pound of gain in live weight.

	Gain in live weight	Consumed per pound of gain	
		Protein	Carbohydrates.
	Pounds.	*Pounds*	*Pounds.*
Lot 1, November 30 to February 22	1,213	0.968	6.00
Lot 1, February 22 to May 30	965	1.570	9.33
Lot 2, November 30 to May 30	1,340	0.911	10.51
Lot 3, November 30 to May 30	1,421	0.909	10.97
Lot 4, November 30 to May 30	1,564	0.934	12.02

With the exception of the second period of lot 1, which is accounted for by the fact that as the animals ripened more and more nourishment was required for each pound of gain, there is here a remarkable uniformity in the amount of protein required to make a pound of gain, regardless alike of the difference in gain and the difference of carbohydrates. I have nowhere in works on feeding seen this relation of protein to gain pointed out, and I venture to call attention to it here because it may be of much practical importance. It suggests that the feeder should base his valuation of any feed almost exclusively on the amount of digestible protein it contains, and instead of buying it by the bushel or by the hundred weight, he should buy it at so much per pound of digestible protein, precisely as artificial fertilizers are bought for the amount of nitrogen, potash, and phosphoric acid they contain. It is a confirmation of the practical value of the "feeding standards" as a guide in feeding, and is in fact simply a presentation of the same principle in a different form. That the amount of protein required for a pound of gain increases as the animal ripens is proven by the diminished gain for the feed consumed. In this connection the following figures, which are deduced from the tables of lot 1, will be of interest:

Grain eaten per pound of gain.

	Pounds.
After 56 days	7.30
After 84 days	8.07
After 112 days	8.40
After 140 days	9.01
After 168 days	9.27
After 182 days	10.00

This simply confirms what is known to every feeder, that it costs more to finish a steer off than it does to give him the main portion of his weight. It shows that the greatest profit is likely to be made if the cattle are marketed as soon as in fairly good condition, other conditions being equal. This being the case, there is but little encouragement for feeders to bring highly finished cattle on the market. The packers do not pay enough more for that class of cattle to pay for the extra feed it requires to put them in condition and leave the same margin of profit to the feeder that he can realize on an animal in only moderate flesh.

[As between barn-feeding and yard-feeding, although lot 4 fed in the yard gained more than lot 3 fed similarly in the barn, they shrunk more in transportation to Kansas City, so that the two lots weighed the same at the time of sale.]

Each steer in the yard ate 844 pounds more corn than the steers similarly fed in the barn, and also somewhat more of the rough feed. [It cost] 12 bushels of corn at 33 cents a bushel, or $4 more per head in feed to feed outdoors than it did in the barn. Whether it is more profitable to pay this tribute to cold weather under outdoor management than to invest it in shelter, each feeder must decide for himself. It should be noted in this connection that on the whole the season was very favorable to outdoor feeding. * * * The gain was very light during the coldest weather. * * *

[As between whole corn (lot 3) and corn meal (lot 2)] it required only 0.8 pound more ear corn than corn meal to each pound of gain. * * * The test can not, however, be considered conclusive. The steers were not accustomed to corn meal, and for some time after the experiment began they did not eat enough to maintain their weight. * * *

Lot 1, fed on the "balanced ration" in the barn, as described elsewhere, stands out conspicuously in comparison with the others. They laid on flesh much more rapidly and on a much less weight of feed for the gain made. * * * They ate well; they seemed to relish the feed; they did not suffer from indigestion or scours, as was the case with a few of the others for brief periods. * * *

The feeding of this lot proves that the balanced ration will fit cattle for market much more rapidly than corn, and that it is unprofitable to continue the feeding much beyond the period of rapid gain. While they gained 1,213 pounds during the first twelve weeks, they gained only 965 pounds during the last fourteen weeks, and that, too, on a considerably richer feed.

At the conclusion of the description of the experiment photographic reproductions are given of two steers from each lot.

Feeding experiments with steers, C. A. GOESSMANN (*Massachusetts State Sta. Bul. No. 44, Oct., 1892, pp. 2-16*).—These experiments were in the same line as a previous one reported in Bulletin No. 40 and the Annual Report of the station for 1891 (E. S. R., vol. III, p. 162, and IV, p. 67), namely, the estimation of the cost of producing beef in the case of growing steers.

The first series of experiments indicated that on the same ration yearling steers made a higher rate of gain than two-year olds, and that in order to fatten beef profitably at the current market prices much care must be exercised in selecting and compounding the feeding stuffs used.

The present trial was with two yearling grade Shorthorn steers, weighing 600 and 675 pounds respectively, and lasted from December, 1889, to March, 1891. This time is divided into three periods, the first winter's feeding, the summer pasturing, and the second winter's feeding. During the first winter's feeding the steers received at different

times sugar beets, corn fodder, corn stover or silage, and wheat bran with gluten meal, or with linseed meal or corn-and-cob meal. In the summer they were turned out to pasture, and the second winter they received wheat bran, cotton-seed meal, and hay, to which barley meal and barley straw were added at different times. Analyses with reference to both food and fertilizing ingredients are given of all the feeding stuffs used. In calculating the financial results account is taken of the value of the fertilizing ingredients of the food, and the following prices are used: Wheat bran $16.50 (first winter) and $23.50 (second winter), gluten meal $23, old-process linseed meal $27.50, cotton-seed meal $27.50, corn-and-cob meal $16.50, barley meal $30, corn stover $5, corn silage $2.75, corn fodder $7.50, barley straw $5, roots $4 to $5, and hay $12 to $15 per ton, and pasturage 40 cents per head per week. The steers were bought at 3½ cents per pound live weight. Full data for the experiment are tabulated. A summary of the gains in weight for each period is as follows:

Live weight of steers.

	Weight at beginning of period	Gain in weight during period.	Average daily gain in weight.
	Pounds.	*Pounds.*	*Pounds*
First winter:			
Steer 1	675	220	1.53
Steer 2	600	240	1.07
Summer pasturage:			
Steer 1	895	125	0.87
Steer 2	840	83	0.58
Second winter:			
Steer 1	1,020	308	1.90
Steer 2	923	231	1.43

The steers were fed at a financial loss. The first winter there was a profit not quite equal to the value of the estimated manure; on pasturage there was a loss of about 3 cents each per day, and the second winter the financial results were less satisfactory than the first winter.

"The results of the second feeding experiment emphasize the statement made in connection with the report of our first experiment, namely, cheaper and more efficient fodder rations than most of our grass lands—meadows and pastures—can furnish have to be devised to render the production of beef for our markets remunerative."

Soiling crops and feeding experiments with soiling crops, C. S. PHELPS (*Connecticut Storrs Sta. Bul. No. 9, Nov., 1892, pp. 16*).

Synopsis.—The experience of the station for four years in growing wheat fodder, clover, oats and peas, oats and vetch, Hungarian grass, scarlet clover, soja beans, cowpeas, and barley and peas for soiling is given, together with a general discussion on the comparative value of legumes and a description of a feeding experiment with soiling crops for milch cows.

"Under the soiling system more stock can be kept on a given acreage than by pasturing; much of the expense of fencing is saved; nearly all of the food given is available for the formation of products, as there is no waste of energy in searching for food; and the manure can be preserved free from waste."

A calculation of the amounts of food ingredients from 1 acre of several different kinds of forage crops, based on the yields and analyses of the crops at the station, are given below:

Valuable constituents per acre.

	Total crop	Protein.	Fat.	Nitrogen-free extract.	Fiber.
Field A, 1890.	*Tons*	*Pounds.*	*Pounds*	*Pounds.*	*Pounds.*
Silage corn	22.0	682	242	[illegible], 546	2,280
Field A, 1891.					
Oats and peas... } Oats and vetch. } Equal areas of each	10.8	605	144	2,036	1,200
Barley and peas	4.9	356	67	714	500
Total, two crops	15.7	961	211	2,750	1,700
Field B, 1892.					
Wheat fodder	10.6	406	200	2,692	1,430
Cowpeas	11.4	570	91	935	730
Total, two crops	22.0	976	291	3,627	2,160

From four years' experience the station recommends the following series of crops for soiling throughout the summer for central Connecticut:

Kinds of fodder.	Amount of seed per acre	Approximate time of seeding.	Approximate time of feeding.
Rye fodder	2½ to 3 bushels	Sept. 1	May 10-20.
Wheat fodder	2½ to 3 bushels	Sept 5-10	May 20-June 5.
Clover	20 pounds	July 20-30	June 5-15.
Grass (from grass lands)			June 15-25.
Oats and peas	2 bushels each	Apr. 10	June 25-July 10.
Oats and peas	2 bushels each	Apr. 20	July 10-20.
Oats and peas	2 bushels each	Apr. 30	July 20-Aug. 1.
Clover rowen (from 3)			Aug. 1-10.
Hungarian	1½ bushels	June 10	Aug. 10-20.
Cowpeas	1 bushel	June 5-10	Sept. 5-20.
Rowen (from grass lands)			Sept. 20-30.
Barley and peas	2 bushels each	Aug. 5-10	Oct. 1-30.

Feeding experiments with soiling crops for milch cows (pp. 9–16).—With a view to studying the value of various green fodders for milk and butter production, feeding trials were made during the summers of 1891 and 1892, four cows being used in each case. During these two seasons green fodder crops were fed from June 1 until November 1; the feeding trials proper lasted from June 8 to September 22, 1891, and from May 29 to August 15, 1892. In 1891 there were three grade Jersey and one Jersey-Guernsey cow, and in 1892 the same cows were used except that one grade Jersey was replaced by another. The amount of green fodder fed varied from 50 to 75 pounds per day, according to the moisture of the crop. The grain was the same for both years, and consisted of 3 pounds of corn meal and 1 pound of new-process linseed meal per day, fed with a small quantity of cut hay or oat straw. The soiling crops tested were wheat fodder, timothy and clover, oats and peas, oats and vetch, Hungarian grass, clover, rowen, and cowpeas. These were fed in periods of four days each in 1891, and

of seven days each in 1892. The data given include analyses of the green fodders fed, analyses of the milk given in different periods, and the calculated amount of butter. A statement is also given showing the food ingredients, potential energy, and nutritive ratio of each ration fed.

In these experiments when clover was fed the amounts of milk and butter were considerably increased and the percentages of fat were higher than during the test with Hungarian grass just before and after those with clover. The average product from four cows during the first series of clover tests (August 10, 14, and 18) of 1891 was 281 pounds of milk and 15.6 pounds of butter, and the average percentage of fat was 5.3 per cent; while for the tests with Hungarian grass (August 3 and 27) the average quantity of milk was 249 pounds, and of butter 12.9 pounds, and the average percentage of fat 5 per cent. * * * The advantages of clover to the dairy farmer may be briefly summed up as follows: It is more valuable than hay or corn stover in the production of milk; it obtains much of its nitrogen from the air and can be grown with mineral fertilizers only; it increases the value of the manure; and it tends to improve the soil by the decay of its roots, stubble, and leaves, which remain after the crop is harvested.

Corn fodder vs. corn silage for milch cows, W. W. COOKE and J. L. HILLS (*Vermont Sta. Report for 1891, pp. 75–86*).

Synopsis.—A comparison between ensiled and field-cured fodder corn for milch cows. Alternate rows of corn were stooked in the field and ensiled respectively. Three cows were fed silage and corn fodder respectively, to which hay and grain were added in four periods of four weeks each, being changed from one ration to the other at the end of each period. The cows gave about 9.1 per cent more milk on silage than on corn fodder, but in general the milk was of poorer quality.

Alternate rows of corn were put into the silo and stooked respectively. The corn fodder was brought to the barn and placed in stooks on a slightly sloping piece of ground. The stooks contained from 400 to 800 pounds. They were drawn together tightly at the top and bound with a cord, and were left standing outside until needed for feeding.

About the first of November a feeding experiment with the silage and corn fodder was commenced with three cows, all fresh in milk. Each cow received 8 pounds of hay and 4 pounds of grain, and in addition two cows received silage and one corn fodder. At the end of four weeks the cow on corn fodder was changed to silage, and *vice versa.* The cows were changed from silage to corn fodder and *vice versa* four times during the trial, so that each cow received corn fodder for two periods and corn silage for two periods. The last twelve days of each period the milk of each cow was analyzed and the amount of water drank was also recorded. Samples of the silage were taken weekly for analysis and samples of each stook of corn fodder as soon as it was cut up. These analyses are tabulated. Data as to the yield and composition of the milk and amount of water drank are also tabulated.

Every time the cows changed from corn silage to corn fodder and back again to silage the average of the amounts of milk given during the two silage periods is larger than that during the fodder period, and when the change was made from corn fodder to silage and back again to fodder the silage proved superior to the

fodder. In other words, the silage yielded per day and per cow more milk than the corn fodder. * * *

In eight cases out of nine corn fodder produced milk with a larger per cent of solids than that given by corn silage, and in seven cases out of nine the milk also has a higher per cent of fat. In general, then, corn silage has given more milk of a poorer quality and corn fodder less milk of a richer quality. The average milk from corn silage contained 12.91 per cent total solids and 4.05 per cent fat; the average from corn fodder, 13.35 per cent solids and 4.28 per cent fat. *

The three experimental cows produced 4,897 pounds of milk while eating 9,089 pounds of corn fodder. At the same rate the whole of the corn fodder would have produced 7,688 pounds of milk. The same cows ate 14,266 pounds of the silage and produced 5,922 pounds of milk, or the equivalent of 8,525 pounds of milk for the whole 20,532 pounds of silage. This makes a total of 838 pounds of milk or 9½ per cent in favor of silage. Calculating in the same way for solids and fat the table below is obtained:

Yield of milk, etc., on silage and corn fodder from equal areas.

	Milk.	Total solids.	Fat
	Pounds.	*Pounds.*	*Pounds.*
Entire corn silage produced	8,525	1,099	345
Entire corn fodder produced	7,688	1,026	329
Gain due to silage	837	73	16
Gain per cent	9.5	7.1	4.6

If the last twelve days of each period are used as a basis for calculating the whole, the gain in favor of silage amounts to 6½ per cent of milk, 3 per cent of solids, and 1 per cent of fat. * * *

[As between ensiling and stooking,] the loss of dry matter is nearly the same, 20 per cent in ensiling and 19 per cent in stooking. The loss of albuminoids is highest in the stooked, so that we should expect from analyses that the dry matter in the corn fodder would have a lower feeding value than that of the silage, and in the feeding trial we find that a pound of dry matter in the silage produced about 9 per cent more milk than an equal amount in the corn fodder.

[These results are compared with those obtained at the Wisconsin Station, with which in general they "agree very closely."] In Wisconsin silage produced 5 per cent more milk than corn fodder, in Vermont 9½ per cent. In Wisconsin silage produced 6½ per cent more butter than corn fodder, in Vermont 4 per cent. * * * [But] in Wisconsin the milk given while eating silage was slightly richer than that given during the corn fodder periods, while in Vermont the milk given on corn fodder was decidedly richer than that on silage. * * *

The cows seemed to like the silage a little better than they did the corn fodder, though they ate the corn fodder with a great deal of relish.

[With reference to the amount of water consumed on the two rations, it is shown that] in seven out of eight tests the cows took more water into the system daily and gave more milk while eating silage than while on corn fodder and in the other case the amounts were equal; thus on the ration which produced the most milk they consumed the most water. When the cows returned at a later period to the same ration they had had earlier they of course gave less milk and took less water in three cases out of four. The average shrinkage in milk was 8 per cent and they took 10 per cent less water. These figures show that cows need to consume more water the more milk they give, and that they will do so whether the food is succulent or dry.

A comparison of clover silage and corn silage fed to milch cows, J. L. HILLS (*Vermont Sta. Report for 1891, pp. 86, 87*).—In a comparison of these foods on ten cows in three periods of eight days each, "the clover silage did not do as well as the corn silage."

Effect of change of quarters on quantity and quality of milk, J. L. HILLS (*Vermont Sta. Report for 1891, pp. 87, 88*).—"On the morning of October 30 the herd was milked for the last time at the old station farm and then driven 3½ miles to their new quarters at the present farm. Composite samples were taken of the milks of seven cows for four milkings before and four after the change." The results of the analyses of these samples are tabulated.

Not only was there a general increase in yield during the two days, but each individual cow gave more at each milking than at the corresponding one before the change. Six out of seven gave a poorer quality after the change. * * *

The quantity gain in the aggregate was greater than the quality loss, so that 6½ per cent larger yield of milk ingredients followed the change.

Experiments in pig-feeding, H. T. FRENCH and C. D. THOMPSON (*Oregon Sta. Bul. No. 20, Sept., 1892, pp. 12, plates 8*).

Synopsis.—Statistics are reported as to the practices in pig-raising in Oregon, and an account is given of a feeding trial made with six pigs, averaging 150 pounds each, to compare whole oats and wheat, fed separately, with the same grains ground and with a grain mixture. Much of the grain fed whole seemed to be undigested.

With a view to ascertaining the general practices among farmers in Oregon, in raising pigs, a circular of inquiry was mailed to seventy-five persons in different parts of the State. Replies were received from sixty of these, which summarized showed that 75 per cent fed their pigs one year or more before slaughtering; that 60 per cent slaughtered their pigs at between 150 and 200 pounds, 30 per cent at between 200 and 250 pounds, and 10 per cent at between 250 and 300 pounds; that pasturage on green wheat, stubble, or woodland was the most common food for growing pigs, and wheat, oats, barley, and screenings for fattening pigs; and that 50 per cent fed the grain whole, while the remainder used more or less ground grain.

An experiment was made at the station with six pigs, all of the same litter, which were divided by weight into three lots, with a sow and a barrow in each lot, and fed from September 1 to December 29—120 days—as follows: Lot 1, chopped oats the first two months and ground wheat the last two; lot 2, whole oats the first two months and whole wheat the last two; and lot 3, mixtures of ground oats and wheat with shorts or barley or both. The grain was soaked before feeding and salt was added. Charcoal was fed regularly.

The pigs were nearly five and a half months old at the beginning of the trial and averaged about 150 pounds each in weight. At the close of the trial they ranged in weight from 286 to 329 pounds. The following is the summary of the results for each lot:

Summary of results of feeding pigs.

	Total gain in weight.	Total food eaten.	Food eaten per pound of gain.	Cost of food per pound of gain.
	Pounds.	*Pounds.*	*Pounds.*	*Cents.*
Lot 1, chopped oats and ground wheat	330.5	1,603.0	4.8	5.9
Lot 2, whole oats and whole wheat	308.0	1,829.5	6.0	7.2
Lot 3, grain mixture	318.0	1,562.5	4.9	5.5

The cost is based on oats and barley at $1 per 100 pounds, wheat at $1.36, and shorts at 90 cents, and apparently no charge was made for grinding. The total gains made during the first two months were, on ground grain, 155 pounds; on whole grain, 183 pounds; and on grain mixture, 262 pounds; and during the last two months, on ground grain, 175.5 pounds; on whole grain, 125 pounds; and on grain mixture, 56 pounds.

The manure was gathered at various times and examined in a mechanical way to determine how much of the whole grain passed through the digestive system without being materially changed. As much as 50 per cent by weight of the entire dry excrement from pigs fed on whole oats and wheat was washed out at different times. The grain was passed in as perfect a condition as when fed, as far as the eye could detect. The same was true of those fed on the ground grain where it was unmixed, except the material was finer. A large portion was to all appearances wholly undigested.

Plates are given showing the relative proportion of fat and lean in the case of the several lots.

Pig-feeding, W. W. COOKE (*Vermont Sta. Report for 1891, pp. 120–127*).

Synopsis.—A comparison was made between sweet skim milk, sour skim milk, and heavy feeding of corn meal for growing pigs. Two lots of three pigs each and one lot of two pigs were fed from May 18 to October 27. The pigs on sour skim milk gave better results in every case than those on sweet skim milk. The pigs fed heavily on corn meal made a larger growth than the others, but at a greater expense for food for each pound of growth. The results of pig-feeding experiments at the station for three years are summarized.

An experiment was made with eight pigs to compare sweet skim milk with sour skim milk and to ascertain how much corn meal can be profitably fed to pigs. The pigs were small Yorkshires, about six weeks old at the beginning of the experiment. They were divided into three lots, two lots containing three pigs each and one lot two pigs. The skim milk was nearly all from deep cold setting. That to be fed sweet was warmed, to take off the chill, and fed at once; that to be fed sour was left in an open tub until it became thoroughly sour and rank, often fully wheyed off. Two ounces of corn meal were mixed with each quart of skim milk and the mixture fed *ad libitum* until the pigs were large enough to take 6 quarts of the mixture per day, after which a mixture of equal parts by weight of wheat bran and gluten meal was added to the ration in increasing amounts. The experiment lasted from May 18 to October 27. Lot 1 received sweet skim milk and lot 2 sour skim milk. Lot 3 was given all they would eat of a mixture of 1 pound of corn meal to 1 quart of sweet skim milk. The amounts of food eaten, gain in live weight, and the food eaten per pound of gain in live weight are tabulated. The lot on sweet skim milk made an average gain during the trial of 158 pounds, the lot on sour milk 175 pounds, and the lot on corn meal 237 pounds. The average total gain in live weight during the trial was 158 pounds for the lot on sweet skim milk, 175

pounds for the lot on sour skim milk, and 237 pounds for the lot on corn meal; and the dry matter eaten per pound of gain in live weight was 2.99 pounds for the lot on sweet skim milk, 2.67 pounds for the lot on sour skim milk, and 2.82 pounds for the lot on corn meal.

[As between sweet and sour skim milk] the sour skim milk produced the better results in every case. To one who watched the pigs from day to day it was not necessary that the pigs be weighed in order to show that they were doing better on the sour skim milk. It was evident within three weeks after the pigs were put on the separate diets that those having the sour skim milk were eating their food with a better relish, were looking sleeker, and growing faster, although both lots ate their food up clean so that they actually consumed the same amount of nutriment.

One of the pigs fed on the heavy corn-meal diet died within three weeks after the test began. The other pig grew faster than the skim milk pigs, but ate a proportionally larger amount of food, so that the cost of pork per pound was greater than in the case of the other pigs. With corn meal and gluten meal at $24 each per ton and bran at $20, there was a profit of $16.78 from feeding the seven pigs. Analyses of the skim milk, corn meal, wheat bran, and gluten meal, with reference to fertilizing ingredients, are given.

The results of pig-feeding experiments at the station for three years are given as follows:

On the average during these three years the pigs have required 1.43 pounds of dry matter in the food to make 1 pound of growth up to the time they weighed 53 pounds, and this amount increases steadily as the pigs increase in live weight, until when they weigh 201 pounds it has required 3.84 pounds of dry matter in the food to produce 1 pound of growth.

Nearly all the pigs cease to yield a profit after they have reached a live weight of 180 pounds.

The value of skim milk has varied in different experiments from 24 to 27 cents per 100 pounds, averaging 25 cents.

With the foods used, skim milk, corn meal, bran, middlings, and gluten meal, the fertilizing value has been on the average 61½ per cent of the cost of the food.

Feeding roots vs. dry food, J. W. SANBORN (*Utah Sta. Bul. No. 17, Oct., 1892, pp. 12*).

Synopsis.—Comparisons of roots *vs.* no roots on fattening steers, pigs, and sheep. Data as to the effect of the roots on the gain in weight, proportion of water in the carcass, character of the meat, etc., are tabulated.

Separate trials were made of feeding roots (mangel-wurzels, turnips, and sugar beets) to steers, pigs, and sheep. Each of these included four or six animals, divided into two lots, one of which received roots and the other none. The steers were fed from December 23 to March 21, receiving hay, corn fodder, and grain; the pigs, from December 24 to April 8, receiving ground oats, peas and barley, and whole wheat; and the sheep, from December 22 to March 28, receiving hay and grain. A record was kept of the food actually eaten and the fluctuations in live weight. At the close of the trials the animals were slaughtered

and parts of the carcasses analyzed. Summaries of these data are tabulated.

In summarizing the results the author states that the root-fed sheep and steers gained more in weight and the root-fed pigs less than those receiving no roots; that the proportion of water in the carcass, shrinkage in dressing, quantity of blood, and weight of the vital organs were all greatest in case of the root-fed animals; and that the proportion of fat was least in the root-fed animals. The meat of the root-fed steers was believed to be less juicy than that of the other lot.

These and several previous trials lead the writer to believe that all immature cattle foods and those foods changed by heat are less nutritious than mature, sound foods.

It is believed that root crops are at present too costly in labor to warrant their extensive growth in Utah for ordinary stock-feeding.

DAIRYING.

E. W. ALLEN, *Editor.*

Composition of milk and its products (*Vermont Sta. Report for 1891, pp. 118, 119*).—"The following tables show the average composition and the fertilizing ingredients of milk and its products, together with the average distribution of both the milk and fertilizing ingredients in butter and cheese-making, being compiled and calculated from the analyses of American experiment stations."

Average composition of milk and dairy products.

	Milk ingredients.						Fertilizing ingredients.			
	Total solids.	Fats.	Casein.	Albumen.	Milk sugar.	Ash.	Nitrogen.	Phosphoric acid.	Potash.	Value per ton.
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	
Whole milk, average	13.00	4.00	2.60	0.70	4.95	0.75	0.53	0.19	0.175	$2.17
Whole milk, maximum	17.00	8.00	3.60	0.90	5.50	0.90	......	......	......	......
Whole milk, minimum	10.00	2.00	1.60	0.40	4.00	0.60	......	......	......	......
Skim milk	9.75	0.30	2.75	0.75	5.15	0.80	0.56	0.20	0.185	2.31
Cream	25.95	18.80	2.00	0.50	4.15	0.50	0.40	0.15	0.130	0.66
Buttermilk	9.50	0.50	2.40	0.60	5.30	0.70	0.48	0.17	0.158	1.98
Whey	7.03	0.50	0.15	0.78	5.00	0.60	0.15	0.14	0.181	0.84
Butter	80.90	85.00	0.60	0.15	0.00	0.15	0.12	0.04	0.036	0.19
Cheese	66.75	35.50	21.65	0.00	4.50	2.10	3.93	0.60	0.120	14.19

"It should be said that the fat percentages in skim milk and buttermilk are lower than will usually be found in shallow-setting work, and that of butter higher than will usually be found in creamery butter."

The distribution of milk ingredients for 1,000 pounds of milk in the cream, skim milk, buttermilk, and butter in butter-making, or in the whey and cheese in cheese-making is calculated to be as follows:

Distribution of milk ingredients in 1,000 pounds of milk and its products.

	Total solids	Fat.	Casein.	Albumen.	Milk sugar.	Ash.	Fertilizing ingredients.		
							Nitrogen.	Phosphoric acid.	Potash.
	Lbs.	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Whole milk, 1,000 pounds...	130	40	26	7	49.5	7.5	5.3	1.9	1.75
Skim milk, 800 pounds....	78	2 4	22	6	41 2	6.4	4.5	1.6	1.50
Cream, 200 pounds........	52	37.6	4	1	8.3	1.1	0.8	0.3	0.25
Butter, 43 pounds....	37 07	36 8	0.23	0.06	....	....	0.05	0.03	0.01
Buttermilk, 187 pounds...	14 91	0 8	3.77	0 94	8.3	1.1	0.75	0.27	0.24
Cheese, 100 pounds	66.75	35.5	24 67	....	4.5	2.1	3.95	0.65	0.12
Whey, 900 pounds	63.25	4.5	1.35	7	45	5.4	1.35	1.23	1.63

In a dairy of twenty cows, giving 4,000 pounds of milk apiece yearly, the total fertilizing value of the milk for a year will approximate $86.80, all of which is lost to the farm if the whole milk be sold, two thirds ($56.80) if cheese is sold and whey retained, one sixth ($13.20) if butter is sold and the buttermilk left at the factory, and one one-hundredth ($0.86) only if butter is sold and both skim milk and buttermilk fed upon the farm.

Abnormal milks, W. W. COOKE and J. L. HILLS (*Vermont Sta. Report for 1891, pp. 111–113*).—Analyses of the colostrum of a cow suffering from milk fever, of the milk of a Jersey cow just before and just after calving, and of a registered Jersey, containing an unusually high percentage of solids and of solids-not-fat, together with a record of this last cow for a few weeks before she went dry.

A Jersey cow which was milked up to the time of calving was found to give milk instead of colostrum after calving. "Succeeding flows were analyzed and found slightly more colostrous than the first. Under the microscope but few colostrum particles were found in the first milk and not many in any of the others."

A registered Jersey cow gave milk of the following composition the last milking before going dry:

	Per cent.
Total solids	28.43
Fat	14.67
Solids-not-fat	13.76
Casein and albumen	9.98
Ash	1.44
Milk sugar, by difference	2.33

"This milk is remarkable for the small amount of milk sugar, the high amount of albuminoids and ash, and the excessively large amount of fat. This, with some other milkings of the same cow, is probably the only milk analysis on record in which the fat is more than the solids-not-fat."

The composition, creaming, and churning of colostrum, J. L. HILLS (*Vermont Sta. Report for 1891, pp. 104–108*).—The average com-

position of the colostrum from the first four milkings after calving of two grade cows and one full-blood Jersey is given as follows:

Composition of colostrum and whole milk.

Average analyses.	Specific gravity.	Total solids. Actual.	Total solids. Calculated	Fat.	Casein and albumen.	Milk sugar.	Ash
		Per cent.	*Per cent.*	*Per cent*	*Per cent*	*Per cent*	*Per cent.*
First milking, colostrum	1.0533	19.37	17 96	3.86	11.44	2.40	1 67
Second milking, colostrum	1 0415	14.33	13 88	2 92	6 19	3.60	1.33
Third milking, colostrum	1.0380	12 98	12 60	2 58	5 01	4.16	1.23
Fourth milking, colostrum	1.0364	13 92	13 55	3 71	4.71	4.28	1.24
Milk three weeks after calving	1 0330	13.52	13.77	4.60	3 34	5.00	0.58

The points to notice are, the higher specific gravity, larger per cent of total solids, ash, and nitrogenous bodies, and smaller per cent of milk sugar in the colostrums than in the milk; and the rapidity with which the fluid becomes more like milk, as shown by analysis and by the closer agreement of actual and calculated total solids. The calculation of total solids depends upon the correct determination of specific gravity and fat, and its results are more or less close to actual total solids as the milk is more nearly normal.

These data would indicate that the fifth and succeeding colostrous milks of the average single cow may be safely used in the mixed milk of a medium sized herd, the eighth and succeeding ones in a small herd.

The composition is given of cream and skim milk from colostrum given by a Devon cow suffering from milk fever. Colostrum was found to cream in cold deep setting more completely than the milk given three weeks after calving. Cream from colostrum and from whole milk was churned sweet in a Frank's Wonder churn.

The colostrum cream as a whole took longer to churn than that from milk. The colostrum butters were vividly yellow and the strong odor of the fluid remained in them in spite of thorough washing. They had the acrid, disagreeable colostrum taste and became rancid much more rapidly than did the milk butters.

Analyses are given of the butter from colostrum and from milk, together with determinations of the melting point, iodine number, and volatile fatty acids in the same.

Composition of butter from colostrum and milk.

	Water.	Curd.	Fat.	Melting point.	Iodine number.	Volatile fatty acids.*
Colostrum butter:	*Per cent.*	*Per cent.*	*Per cent.*	°C		
First milking				39.6	36.8	22.6
Second milking				38.6	35 7	24.9
Third milking				37.8	36 1	31.1
Fourth milking				38 9	36.3	29.9
Average	14.15	0.87	84.98	38.7	36.2	27.1
Milk butter	15.21	0.51	84.28	37.4	37.5	28.4

* C.c. of deci-normal alkali required for 5 grams of fat.

The use of a formula for calculating the per cent of total solids in milk, W. W. COOKE and J. L. HILLS (*Vermont Sta. Report for 1891, pp. 114–117*).—The following simplification of the Hehner and Richmond

formula is suggested for the calculation of solids in milk: $T=1.2\,F+\frac{L}{4}$, in which T=total solids, F=fat, and L=lactometer reading at 60° F. "In other words, one fourth the lactometer reading added to one and one fifth times the fat gives the total solids." Directions are given for the detection of adulterations of milk with the aid of this formula.

Results of analyses are given of whole milk and separator skim milk from the same, which make it evident "that the milk serum is not influenced by the separator and that the only difference between whole milk and the skim milk derived from it is in the amount of fat they contain."

A comparison of the composition of the skim milk from a "cheese cow" and a "butter cow" is given, showing that "the difference in market value is too small to be noticed, about 1 cent for 100 pounds, but whatever difference there is is in favor of the skim milk from the butter cow."

Creaming of milk in cold setting, W. W. COOKE (*Vermont Sta. Report for 1891, pp. 100–103*).—These were tests of the proximity to the cream line to which the skim milk may be drawn off without causing loss of cream. The results imply that if skimming is done with care it is safe to skim down very close to the cream. Tests were made of the fat in skim milk taken from different parts of the can after standing in cold deep setting for twenty-four hours. The results imply that "the skim milk is alike in composition from the bottom of the can to within a very short distance of the cream, and that even this small amount of skim milk is but a trifle richer than the bulk of it."

Cream-raising by dilution, W. W. COOKE (*Vermont Sta. Report for 1891, pp. 103, 104*).—The milk of fresh cows and of "strippers" was set at 42° F., diluted one fourth with water at 135° and undiluted; at 55°, diluted one fifth with water at 130° and undiluted; and at 60°, diluted one fourth with water at 135° and undiluted. In the case of fresh cows there appeared to be a gain from diluting milk with hot water when it was set at 55° or 60°, and in the case of cows well advanced in lactation the only gain from dilution was when the milk was set at 60°.

A new method of testing cows, W. W. COOKE (*Vermont Sta. Report for 1891, pp. 108–111*).—Studies have been made at the station with a view to determining some practical means of creaming and churning milk in short tests of cows. The Baby Separator No. 2, Alpha pattern, was found to give unsatisfactory results with so small an amount of milk as that from one cow at a single milking, but it was found possible to keep cows' milk sweet for three or four days by placing it in cans submerged in ice water, and if the milk was then heated to from 90° to 95° F. the cream could be separated as thoroughly as from milk fresh from the cows. The plan proposed for a week's test is to separate the milk of the first four days and of the last three days each by itself,

keeping the milk in the meantime submerged in ice water, and to churn the cream in a barrel churn while sweet. The fat in the bowl of the separator is cleaned out by running through a quantity of skim milk after separating the whole milk. The results are given of a seven days' test made in this way of the milk of a single cow. In this test "95 per cent of the fat in the whole milk was recovered in the butter. When reduced to the 80 per cent standard this cow would be credited with 10.37 pounds of standard butter, or 119 pounds of butter for each 100 pounds of fat in the original whole milk."

Creamery work, W. W. COOKE and J. L. HILLS (*Vermont Sta. Report for 1891, pp. 59-74*).

Synopsis.—The results are given of studies at a creamery with reference to the following points: Variations in composition of milk, effect of change from barn to pasture, effect of weather, losses in butter-making, and variation in composition of creamery butter. The percentage of fat was found to vary in single cow's milk by 0.87 and in mixed herd milk by about 0.4 from day to day. The change from barn-feeding to pasturage was accompanied by increase in yield of milk and in percentage of fat, amounting to an increase of about a quarter of a pound of butter per cow per day. On an average 92.5 per cent of the fat in the milk was recovered in the butter in butter-making. The amount of butter made per 100 pounds of fat in the milk ranged from 101 to 115 pounds, averaging 110 pounds.

With a view to studying the variation in the composition of milk, the effect of change from stall-feeding to pasturage, losses in butter-making, variations in creamery butter, relation between butter fat and buttermilk, etc., an extensive series of tests were made during the spring of 1891 at a creamery having about thirty patrons. From May 6 to June 7 samples were taken daily of the milk brought by each patron, and for six weeks following this that from four herds selected as being the best for further experimental work. Samples were also taken daily of the separator skim milk, the buttermilk, and the butter. These samples were all taken to the station for analysis. "At the time the test began all of the herds were being kept in the barn, and a record was made of the day when each was turned out to pasture, of the changes in feed, and of all changes in the herd by the addition or subtraction of milch cows." Summarized data are tabulated for each point.

Variations in milk (pp. 61-65).—Illustrative of the variation in percentage of fat in the milk of cows from day to day, analyses are given of mornings' and nights' milk of a grade Jersey cow on eight consecutive days, the food, environment, and time of milking being exactly the same each day. The highest percentage of fat found was 5.38 and the lowest 4.45, a difference of 0.87 per cent. A difference as high as 0.65 per cent was found between the mixed milk (morning and evening) of different days. This point is of interest in connection with sampling. The variations which may occur from day to day in the composition of the mixed milk of a herd are illustrated by analyses of the mixed milk of a herd of thirteen cows for a period of thirty-two days. The percentage of fat ranged from 3.63 to 4.59, an average of 4.19, and the amount of fat from 6.48 to 11.78 pounds per day.

In most creameries milk is paid for once a month, and it is necessary to get some per cent of fat that shall correctly represent the average quality of the milk for the month. Theoretically, the only way to be sure of a correct average is to analyze a sample of each day's milk, but this means so much work that no one could afford to do it. * * * It can be said that there is no need of analyzing every day or taking a composite sample. If 8 samples are taken during the month the result will be sufficiently accurate.

Effect of weather on quantity and quality of milk (pp. 65–69).—A diagram is given showing the variation in the quality of the milk with the variation in temperature, and a table showing the amount and composition of the milk previous to and following storms.

There would seem to be a general tendency of the quality of the milk to become richer when the temperature was falling, and less rich during a rising temperature. * * * During the period of increasing yield, previous to the middle of June, there seems to be some connection between quantity of milk and the temperature, since each case of a decrease in quantity is at or within twenty-four hours of a sharp fall of temperature. After the middle of June but little connection can be traced. The quantity of butter fat produced does not seem to have varied much from either cause. * * *

[Concerning the changes in the milk occurring simultaneously with storms,] if we consider these changes to be due to the effect of rain storms, they would seem to indicate that cows in flush of milk on pasture feed give as much or more milk and of just as good quality in bad weather as in fair weather, and that when the storm is over they give a less quantity of richer milk. The cows do not appear to have made any change in quantity or quality of milk on the approach of a storm, and no connection is traceable between the storms and the pounds of butter fat produced.

Effect of change from barn to pasture (p. 69).

This was very marked in the case of all of the herds. After making allowances for the milk of fresh cows added to the herds, there is still left an increase of about 16 per cent in quantity of milk due to the pasturage, notwithstanding the fact that most of the herds had grain while in the barn and none while on pasture. There was also a gain in quality of milk on pasture amounting to about a third of a pound of butter to each 100 pounds of milk. These two results combined make the entire effect of change from barn to pasture a gain of about one fourth more butter per day per cow.

Losses in butter-making (pp. 69–71).—Averaging the results of twenty-two days, the average per cent of fat in the separator skim milk was 0.19 and in the buttermilk 0.6. This was equivalent to a daily loss of 11.6 pounds of fat in the skim milk and 10.3 pounds in the buttermilk. The average churnability of the milk, that is, the average percentage of the fat of the whole milk which was recovered in the butter, was 92.5 per cent.

A well-known writer on dairy topics has made the statement that on the average in private dairies not more than 75 per cent of the fat in the whole milk is recovered in the butter. As compared with this, the average of 92.5 per cent shows that this creamery did creditable work. On its best day only 4 pounds were lost out of 100, and if it is possible to do this once it should be equally possible, by taking sufficient care, to do it every day. * * *

There is nothing to indicate that the change from barn to pasture, *i. e.*, from dry feed to succulent, or the changes of the weather had any influence on the work of the separator or any effect on the churnability of the cream.

Variations in creamery butter (pp. 71, 72).—Analyses of the butter made at the creamery on twenty-seven days, the results of which are tabulated, show that even under the uniform conditions prevailing the percentage of water varied from 10.43 to 14.70, averaging 12.35, and the percentage of fat ranged from 79.65 to 85.14, averaging 82.93. The butter had received but one working.

Mechanical losses in creamery work (pp. 72, 73).—The difference, if any, between the sum of the fat in the skim milk, buttermilk, and butter, and in the whole milk is taken as mechanical loss. This was determined at the creamery on thirty-two days. The mechanical loss per day ranged from 0.03 to 20.2 pounds and averaged 3.27 pounds, which is "probably quite close to the truth and represents the amount of butter sticking to the various utensils." The quantity of milk required to make 1 pound of butter ranged from 22.43 to 25.25 pounds, averaging 23.87 pounds.

Relation between butter fat and butter (pp. 73, 74).—The amount of butter made from each 100 pounds of butter fat in the milk ranged for thirty-two days between 104.4 and 115.6 pounds, averaging 110.1 pounds.

> It is evident that no set rule can be given, since varying amounts may be lost in the skim milk and buttermilk and the butter may contain widely varying amounts of fat, water, and salt. * * * The best of work should yield fully 15 per cent more butter than butter fat, though this result would be obtained but rarely in creamery work.

Making cheese from milk of different qualities, W. W. COOKE and J. L. HILLS (*Vermont Sta. Report for 1891, pp. 88–95*).

Synopsis.—Cheese was made from milk containing 3, 4, and 5 per cent of fat, respectively. The two richer milks gave the best cheese. Milk with 4 per cent of fat gave a larger yield of cheese than that with 3 per cent, and about the same as that with 5 per cent. The results indicate that in the case of very rich milk the fat content is not always a true index of the value of the milk for cheese-making.

To study the economy of using milk rich in fat for cheese-making, with reference to determining whether the fat content is a fair basis for paying for milk at cheese factories, cheese was made at the station from milk containing 3, 4, and 5 per cent of fat, respectively. This milk was prepared by adding separator skim milk and cream, respectively, to milk containing 4 per cent of fat. This naturally gave abnormal milk as far as the casein was concerned, the milk with 5 per cent of fat containing only 2.3 per cent of casein. "It would therefore be harder to work this milk without loss of fat than would ordinarily happen in the fall when the general run of milk contains 5 per cent of fat as delivered at the factory."

Whether the fat can be saved as perfectly in rich milk as in poor, the results imply that "there is no necessity of wasting fat in the whey when making cheese from 5 per cent milk. It is only fair, however, to add that the curd from the 5 per cent milk was very tender, and if the cheese maker had not understood his business and had not taken extra care there would surely have been a large loss of fat."

The percentage of albuminoids (casein and albumen) in the whey was the same from the three kinds of milk—about 95 per cent. According to the analyses of the cheese, that made from milk with 5 per cent fat contained the lowest percentage of water and that from milk with 3 per cent fat the highest percentage of water, and the percentage of fat in the cheese followed the same order. The cheeses were carefully cured and samples were sent to four cheese experts for scoring. All the experts pronounced the cheese from the milk with 3 per cent fat the poorest, while they were equally divided as to the quality of the cheese from milk with 4 and with 5 per cent fat. The cheese from milk with 3 per cent fat was rated three fourths of a cent per pound lower than that from the other milk.

"The figures show that in this test cheese made from 3 per cent and 4 per cent milk was valued on the Boston market exactly in proportion to the amount of butter fat contained in the milk from which it was made, but that in using the 5 per cent milk for cheese-making there was a loss from what would have been obtained had the milk been made into butter."

The results of three other trials at the station in making cheese with milk containing from 4.27 to 4.40 per cent of fat are also tabulated, and reference is made to experiments in making cheese from milk containing varying percentages of fat, reported in Bulletin No. 37 (new series) of the New York State Station and Bulletin No. 19 of the Minnesota Station (E. S. R., vol. III, pp. 610 and 797). While the cheese from milk with from 3 to 4 per cent fat was valued almost exactly in proportion to the amount of butter fat in the milk, this rule does not hold for milk above 4 per cent, for milk with 5 per cent fat did not make a pound more of cheese per 100 pounds of milk, owing to the greater dryness of the cheese from rich milk, and the markets will not pay more for the extra rich cheese than for moderately rich cheese.

Milk containing much over 4 per cent fat can be more profitably made into butter than into cheese. As a conclusion, then, from the data that have thus far become available, it can be said that with milk varying from 3 to 4 per cent, paying for the milk according to the butter fat it contains gives probably exact justice, while for milk under 3 per cent and over 4 per cent the agreement is not so close, and a great deal would depend on the skill of the cheese maker and the market to which the cheese was sent.

Losses in cheese-making (*Vermont Sta. Report for 1891, pp. 95–100*).

Synopsis.—The losses in a three days' test of cheese-making were determined. The mechanical loss was found to be very slight, the main source of loss being the whey and the drippings from the cheese press. About 90.5 per cent of the fat and 97 per cent of the casein in milk was recovered in the cheese. The percentages of the whole amount of the milk ingredients which appear in the cheese, the whey, and the drippings are estimated. The changes in cheese in ripening are mentioned.

Tests lasting three days were made at a cheese factory in the State with a view to determining the mechanical losses of fat and other

ingredients in the manufacture of cheese. Composite samples were taken of the milk brought by the different patrons each day, and these were analyzed, together with samples of whey, curd-sink whey, curd drippings from the cheese presses, and the green and ripe cheese. From these data the total amounts of fat in the whole milk and in the cheese products are calculated for each day and tabulated.

The tabulation shows but slight mechanical losses expressed in percentages of the total ingredients present, and an apparent gain is as frequent as a loss. All of these gains and losses are well within the limits of the admissible errors of chemical analysis. Each ingredient, however, being determined at least twice in duplicate samples, this source of error is lessened; yet to it and to the unavoidable errors of sampling we may justly credit the gains. * * *

It may be quite surely said that there is little or no mechanical losses of any of the milk ingredients in cheese-making by the stirred-curd process.

The losses of fat in the wheys were above the average. Considering 21 per cent of the nitrogen solids to be albumen and that all the albumen passed into the whey, an assumption which is nearly true, the following per cents of total fat and casein present in milk were not in the waste products, and consequently, assuming no mechanical loss, were present in the green cheese.

Amounts of materials saved in the cheese for each 100 pounds contained in the original whole milk.

	Fat.	Casein.
	Pounds.	*Pounds.*
First day	90.8	96 6
Second day	91.5	97.0
Third day	89 2	97 3
Average	90 5	97.0

Had the same amount of milk been made into butter, with 0.20 per cent fat in the skim milk and 0.50 per cent in the buttermilk, both good average separator creamery work, about 94 per cent of the fat would have been available for butter.

Distribution of ingredients in cheese-making (pp. 98, 99).—These were calculated from the tests reported above to be as follows:

Approximate average distribution of ingredients in cheese-making.

	Whey.	Cheese-press drips	Cheese.
	Per cent.	*Per cent.*	*Per cent.*
Total solids	44.9	0 9	54.2
Fat	0.9	0.4	90.6
Casein	22	0 6	77.4
Milk sugar	93.5	1.5	0.5
Ash	63	1	36
Salt	2	23	75

Changes in the ripening of cheese (pp. 99, 100).—Analyses were made of the green and the ripe cheeses made on each of the three days, and from these the total amounts of ingredients in the cheese were calculated. "The tests may be considered as indicating that during the first month the main changes in the ripening cheese are a loss of moisture, a possible mechanical loss of fat, and a slight loss in casein."

Cheese and butter-making, R. J. REDDING and H. J. WING (*Georgia Sta. Bul. No. 18, Oct., 1892, pp. 213–221*).—This is a popular bulletin containing a description of the station dairy house, remarks on dairying in general, directions for butter-making and cheese-making, description of an outfit for a twenty-cow cheese dairy, and an account of cheese-making at the station. It is believed that "so far as the experience of one entire summer season can determine, the climate and other natural conditions of Georgia are fully equal and in some respects superior for cheese-dairying to those of Ohio or New York." The station offers to give instruction in butter-making and cheese-making.

In an appendix to the bulletin farmers are cautioned against paying fabulous prices for the "domestic coffee berry," which is said to be nothing more than the soja bean or Japan pea.

TECHNOLOGY.

Effect of altitude on maple-sugar-making, J. L. HILLS (*Vermont Sta. Report for 1891, pp. 160–162*).—In Bulletin No. 26 of the station (E. S. R., vol. III, p. 246) it is recommended to heat sirup to certain temperatures in sirup and sugar-making. These recommendations were made on the basis of tests conducted at an altitude of about 500 feet above sea level. In this article an account is given of tests made at different altitudes.

The work was done at the experiment station at Burlington, and at the residences of Hon. V. I. Spear and F. H. Packard, Braintree.

A few samples were lost by unavoidable accident, but one hundred and twenty polarizations were made on samples taken, and they, with other data, may be summarized as follows:

Location.	Station	Mr. Spear's.	Mr. Packard's.
Altitude above sea level (feet)	375	1,025	1,585
Water boiled at (°F.)	212-	210.50	210
Sirup No. 1 (°F.)	218	217-	216
Sirup No. 2 (°F.)	217	216	216-
Sirup No. 1, average percentage	71.61	71.68	72.11
Sirup No. 2, average percentage	65.93	66.19	67.80
Sirup No. 1, per cent sugar at 225° F	71.56	72.42	73.47
Sirup No. 2, per cent sugar at 225° F	65.18	66.66	68.35

The average percentage is obtained by adding percentages obtained at the five various degrees and dividing by five. It is much the same as results at 225°, which is about midway between boiling and sugaring-off point. Three thermometers, two chemical standard and one sugar, were used in this work, all agreeing within a fraction of a degree at points between 212° and 235°. * * *

These tests seem to indicate that if sugaring-off at higher altitudes than 500 feet above sea level does materially affect the grade of sirup or sugar made at the temperatures prescribed in Bulletin No. 26, the alteration will tend to improve the grade.

AGRICULTURAL ENGINEERING.

Irrigation and duty of water, B. C. BUFFUM (*Wyoming Sta. Bul. No. 8, Oct., 1892, pp. 32, figs. 3*).—Information, "largely compiled from other authors, with such additional material as has been suggested by observation and experiment," on the extent and distribution of irrigated areas in Wyoming, water supply, and methods and effects of irrigation; and when and how to irrigate for grasses, cereals, root crops, vegetables, and fruits. The self-irrigating instrument (nitometer) devised by E. Mead for measuring the time and depth of flow over weirs, and that devised by D. A. Carpenter, are illustrated and briefly described, and the duty of water as observed at Laramie during 1891 and 1892 on mixed crops, oats, sugar beets, ruta-bagas, corn, cane and durra, and peas and beans, are tabulated. The following summary is taken from the bulletin:

(1) The opportunity to construct large irrigation works to reclaim large tracts of land in Wyoming is excellent.

(2) Overirrigation is pernicious and must be avoided.

(3) Of the methods of irrigation, flooding is the most injurious to cultivated crops, but the most economical method for grass lands and cereals. Row irrigation is recommended for all crops where it is convenient to apply it. Subirrigation is the most expensive, but most favorable to the majority of crops. It works best on rather heavy soils with impervious subsoils.

(4) So far as determined in this State, the duty of 1 cubic foot per second continuous flow varies from 93.6 to 735.3 acres.

STATION STATISTICS.

Reports of director and treasurer of Vermont Station for 1891 (*Vermont Sta. Report for 1891, pp. 9–44*).—The report of the director contains brief general statements regarding the publications, farm buildings, and work of the station, together with abstracts of Bulletins Nos. 26, 27, 30, and 33 (E. S. R., vol. II, p. 744; III, pp. 246 and 890; IV, p. 195).

Since the last report was published the buildings have been completed on the new farm, lately purchased, adjoining the university grounds.

The farm is admirably adapted for an experimental farm, comprising 80 acres, varying from heavy clay, through gravelly loam and clay loam, to a sandy loam. Most of it is already in a high state of cultivation, and the crops taken from it the past year have more than equaled expectations. The trustees of the university have lately purchased 30 acres more, to be used as a pasture.

The barn is 48 by 105 feet, with 22-foot posts, the floor of the cow stable being on a level with the sills and directly over a large cellar 45 by 80. * * * The first floor contains, besides the cow stable, which can accommodate thirty-five head of stock, tool room 20 by 40, carriage room 23 by 25, horse stall and harness room 20 by 25, a carriage wash rack, a sheepfold, and a model piggery, each 20 by 20, while just outside are three bull pens for the three different breeds of cattle kept. The floor above is the main barn floor, and the hay mows on each side hold about 100 tons of

hay. The grain bins hold over a car load. Over the sheepfold and piggery and the tool and carriage rooms are large seed and storage rooms. In the northeast corner of the barn, reaching from cellar to roof, are three great silos, which will hold nearly 200 tons of silage. * * *

Two features of the barn call for particular attention, ventilation and watering. The ventilating shafts pass from manure cellar to cupola, being 51 feet in perpendicular height. There are eighteen 8 by 20-inch shafts which open into the roof shafts, and they have thus far given satisfaction. Each has openings on each floor, and any part of the barn can be ventilated at will.

Watering the cattle is done by what is known as the Buckley watering device. Fastened on a post in front of the stanchion, between each two cows, is an iron bucket holding a little over a gallon. They are all connected by an iron pipe with a water tank containing a ball valve. Any draft of water in any bucket lowers the level and water flows into the tank to restore it. * * *

On the first floor of the creamery building are a separator room 24 by 22 feet, churn room 24 by 14, and ice house 25 by 14; and on the second floor, laboratory for milk-testing 24 by 22, and lecture room 24 by 14. At the other end of the same building are a carpenter shop 19 by 20, and a potting room 19 by 20; and upstairs, botanical and horticultural laboratories, both 19 by 20. * * *

The greenhouse is a glass structure 80 by 24 feet, with a southern exposure. It is divided into four rooms, heated by a hot water boiler, and so piped that the temperature can be controlled in each division, making it possible to grow plants of the tropical as well as the temperate zones. The two eastern rooms are used by the botanist in the study of the fungous diseases of plants. * * * The two western rooms are devoted to gardening under glass.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Grasses of the Pacific Slope, part I, G. VASEY (*Division of Botany, Bul. No. 13, Oct. 20, 1892, pp. 60, plates 50*).—The scope and purpose of this publication are stated in a brief introduction, as follows:

> The grasses which are known to grow on the Pacific Slope of the United States, including Alaska, number not far from 200 species. These are all specifically distinct from the grasses growing east of the Mississippi River, and also mainly distinct from the grasses of the plains and of the desert, except in that part of California which partakes of the desert flora.
>
> A considerable number of grasses of the mountain regions of California, Oregon, and Washington reappear in the mountains of Idaho, Montana, and the interior Rockies. The interior of California is a dry region, verging in the extreme south into the desert country, and is deficient in grasses, especially of those species which form a continuous turf. In this part of the present bulletin we have figured and described mainly those grasses which are most conspicuous in size and apparent utility. Nearly all are here illustrated for the first time. The work will be of great value not only to botanical students, but to all persons interested in agriculture and in the raising of domestic animals.
>
> The descriptions are almost wholly the work of my assistant, Prof. L. H. Dewey.

The following species of grasses are described and illustrated: *Agrostis æquivalvis*, *A. densiflora*, *A. exarata*, form *asperfolia*, *A. hallii*, *A. humilis*, *A. tenuis*, *Alopecurus alpinus*, *A. californicus*, *A. geniculatus*, var. *robustus*, *A. howellii*, *A. macounii*, *A. saccatus*, *A. stejnegeri*, *Aristida californica*, *Calamagrostis aleutica*, *C. bolanderi*, *C. breweri*, *C. crassiglumis*, *C. cusickii*, *C. densa*, *C. deschampsioides*, *C. howellii*, *C. purpurascens*, *C. tweedyi*, *Cenchrus palmeri*, *Deschampsia cæspitosa*, *Hierochloe macrophylla*, *Imperata hookeri*, *Muhlenbergia calamagrostidea*, *M. californica*, *M. debilis*, *M. dumosa*, *M. parishii*, *Orcuttia californica*, *O. greenei*, *Oryzopsis exigua*, *O. webberi*, *Panicum urvilleanum*, *Phalaris amethystina*, *P. lemmoni*, *Stipa coronata*, *S. eminens*, *S. kingii*, *S. occidentalis*, *S. parishii*, *S. setigera*, *S. speciosa*, *S. stillmani*, *S. stricta*, *Trisetum californicum*, *T. canescens*, and *T. cernuum*.

The California vine disease, N. B. PIERCE (*Division of Vegetable Pathology, Bul. No. 2, pp. 222, plates 25, charts 2*).—This bulletin gives a general statement regarding the grape industry in California and the destruction caused by the vine disease; a history of the origin and growth of the grape industry in California; the special characters of the disease; the development of the disease in southern California; the rela-

tions of soil, shade, rainfall, and temperature to the disease; the treatment, growth, and variety of vines; the relationship of the disease; and suggestions for treatment.

The author was engaged for ten months in California and five months in France, Italy, and Africa in a special investigation of grape diseases, seeking to find some clue to the cause of the disease which in southern California threatens the destruction of the grape industry.

The disease appeared at Anaheim about 1884, and with this as a center has spread rapidly in all directions, often causing the complete destruction of vineyards. All kinds of vines seem to be susceptible to attacks of this disease, but those derived from *Vitis vinifera* seem to suffer the most.

The disease may be characterized as follows: Sharply defined spots of red or yellow of varying size appear on the leaves and extend through them. The tissue in such spots and between the veins dies, leaving a narrow band of green parenchyma. The canes are often stunted and more or less flattened on one side, and become leafless, dry, and black. Where there is immature growth the black discoloration is most conspicuous. The sap is less abundant and its flow slower. The last part to lose its sap to any great degree is the stock below ground. The roots show a shrinkage and discoloration, followed by decay. The actively growing parts, such as the root fibers and root hairs, are the first to be attacked, and their destruction has an immediate effect upon the plant. The fruit usually shrivels and dries upon the vine. The disease seems to go through a period of incubation before it becomes externally manifest, and this period may be longer or shorter according as the vine is resistant or easily affected. The conditions of soil, irrigation, atmosphere, shade, rainfall, fogs, temperature, and winds are all considered at greater or less length, yet in none of them does the author find an adequate cause for the disease.

The disease is compared with all parasitic and nonparasitic diseases of grapes known in this country and in the south of Europe, but it is unlike any of them. The only known fungus affecting the vine in a way at all similar to this disease is the powdery mildew (*Uncinula spiralis*), and to this such virulent power has never been attributed. In external appearance the disease resembles in a general way "rougeot" and "folletage," two south European diseases of unexplained origin, but the total effect is wholly unlike that of either of them. The subject has been examined from a bacteriological point of view, but so far with negative results.

No fungicide experimented with has produced lasting effects. Bordeaux mixture seems to act upon the diseased vines as a stimulus, causing them to start out new canes, but the effect is only temporary, the vines usually dying in a season or two. Sulphur, which is an effectual remedy for the powdery mildew, seems to have no effect in this case.

The general conclusion is that the specific cause of the disease is still unknown and that no fungicide tried will avail much upon diseased vines. The author thinks that the planting of healthy cuttings and the use of Bordeaux mixture along with the sulphur treatment for the powdery mildew would probably be advantageous and profitable.

Report of experiments made in 1891 in the treatment of plant diseases, B. T. GALLOWAY (*Division of Vegetable Pathology, Bul. No. 3, pp. 76, plates 8*).—Experiments were conducted in the treatment of black rot of grapes, apple scab, leaf blight, cracking and scab of pears, diseases of nursery stock, peach rot, plum leaf blight, quince spot, and the fungous diseases of the grape.

In the treatment of vines for black rot Bordeaux mixture gave the best results, even when reduced to one sixth the strength of the usual formula. Four treatments, the last when the berries were the size of bird shot, were found to be nearly as effective as six continued until the berries were full grown.

For apple scab, E. S. Goff, of Wisconsin, found Bordeaux mixture the best of the copper compound solutions, while Paris green, 1 pound to 200 gallons of water in which just enough lime was stirred to make the whole milky, gave the best results, surpassing any of the others alone or in combination.

For the treatment of pear leaf blight and pear scab Bordeaux mixture gave the best results when both were treated together. If treated separately ammoniacal copper solutions gave the best results for the leaf blight and copper saccharate and glue mixtures were best for pear scab. For the treatment of the diseases of nursery stock, Bordeaux mixture was, on the whole, the most satisfactory fungicide. The same is also true in the treatment of quince spot.

Negative results were obtained in several experiments on account of the nonappearance or very light attack of the disease even on untreated plants.

In answer to a circular letter sent out by Assistant Secretary Willits to grape growers, requesting data as to the use of fungicides and extent of loss caused by fungous diseases, about two thousand five hundred reports were received from thirty-five States and Territories. Two thousand made some use of the treatments suggested in Farmers' Bulletin No. 4 on Fungous Diseases of the Grape (E. S. R., vol. II, p. 609), and eighteen hundred report beneficial results. The loss for the previous year as reported in these letters was, from black rot 65 per cent, from downy mildew 25 per cent, and from powdery mildew 10 per cent. Only two hundred and fifty persons, from twenty-one States, reported their net profit from spraying, the average being $122.93 for each grower.

Yield of crops per acre (*Division of Statistics, Report, Nov., 1892, pp. 16*).—The estimated average yields of corn, potatoes, buckwheat, sorghum, tobacco, and hay. The prospects of cotton, apples, pears, and grapes are also reported.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Notes on W. F. K. Stock's nitrogen process, W. P. SKERTCHLY (*Analyst, 1892, pp. 209–215*).—This method* was compared with the Kjeldahl method in the determination of nitrogen in pure crystallized ammonium sulphate, dog biscuit, cotton seed meal, wheat flour, coffee, gelatin, linseed cake, crushed hoofs and horns, fish guano, dried blood, and manure. As a rule the Kjeldahl gave slightly higher results than the Stock method. The author is of the opinion that the mixture of sulphuric acid and manganese dioxide which is used acts upon nitrogenous substances in much the same way as a mixture of sulphuric acid and potassium permanganate, causing a loss of ammonia. His experience leads him to believe that the method requires much careful study and possibly modification before it can be accepted by analysts as a reliable method for determining nitrogen in common organic substances.—E. W. A.

On the determination of phosphoric acid in Thomas slag, A. F. JOLLES (*Zeitsch. analyt. Chem., 31 (1892), pp. 516–519*).—The author has found differences in the results by the Maercker and the molybdic methods on Thomas slag which were proportional to the amount of lime in the slag. These differences are attributed to the fact previously pointed out, that the gypsum precipitated by the sulphuric acid added to dissolve the slag envelops particles of the phosphate of lime, preventing their being brought into solution. He has noticed similar losses of phosphoric acid where hydrochloric acid was used as the solvent. He describes the Albert method,† which consists in evaporating 5 grams of finely ground slag nearly to dryness with 500 c. c. water and 40 c. c. hydrochloric acid of 16 to 20° Bé., taking up in 500 c. c. of water and filtering; treating an aliquot (50 c. c.) of the filtrate with 15 c. c. of Joulie's solution (400 grams citric acid made to a liter with ammonia of 0.9 sp. gr.), and precipitating the phosphoric acid with magnesia mixture in the ordinary manner. The author finds that this method gives too high results, due, he suggests, to incomplete separation of the silica. He proposes the following modification of the Albert method for determining phosphoric acid in Thomas slag meal: Five grams of slag meal are moistened in a dish with a little water, 40 c. c. of hydrochloric acid of

* Analyst, 1892, pp. 109–113; E. S. R., vol. IV, p. 86.
† Zeitsch. angew. Chem., 1891, p. 280.

about 20° Bé. added, and the mixture evaporated completely to dryness. The residue is heated in an air bath at 120° C., and on cooling is moistened with hydrochloric acid, taken up in water, and filtered. The filtrate is made to 500 c. c., 50 c. c. treated with citrate solution, and the phosphoric acid precipitated as usual with magnesia mixture, dried, incinerated, and weighed.

By this method he has secured results agreeing very well with those by the molybdic method, but he holds that the molybdic method should always be resorted to in making control analyses.—E. W. A.

Method of determining lime in Thomas slag, A. F. HOLLEMAN (*Chem. Ztg., 1892, pp. 1471, 1472*).—The methods proposed by Classen and by Jones have been found inadequate in case of materials like Thomas slag meal, containing iron and manganic phosphates, as the precipitated lime contains admixtures of iron and manganese. The author studied the methods with reference to improving them by modification, and found that a combination of the two methods gave satisfactory results. According to this modified method nearly all of the iron and part of the manganese are removed in the first precipitation, and the remainder of the iron and manganese in the second precipitation. The method, as used, is described as follows:

Fifty c. c. of the slag solution, equivalent to 1 gram of substance, is evaporated well down, 20 c. c. of neutral potassium oxalate solution (1 to 3) added to the residue, and heated on a water bath, with frequent stirring, until the precipitate is pure white and free from lumps. This usually transpires after ten minutes' heating. The precipitate is filtered and washed with hot water until the filtrate contains no oxalic acid. The calcium oxalate should now be snow white. The filter is punctured and calcium oxalate washed through, first with water and finally with warm dilute hydrochloric acid (1 to 1). The calcium oxalate is dissolved by adding about 15 c. c. of concentrated hydrochloric acid, the solution evaporated to a volume of about 25 c. c. and 10 c. c. of dilute sulphuric acid (1 to 5) and 150 c. c. of 96 per cent alcohol added. After standing three hours or more the precipitate is filtered off and washed with 96 per cent alcohol until the washings show no acid reaction with methyl orange. The gypsum precipitate is then dried to constant weight. By this method a very pure precipitate of calcium sulphate was obtained containing only traces of manganese, and the results of duplicate determinations agreed very closely. Triplicate determinations in a sample of Thomas phosphate showed 41.75, 41.75, and 41.67 per cent of calcium oxide, respectively.—E. W. A.

Recent researches on the fixation of atmospheric nitrogen by microbes, BERTHELOT (*Compt. rend., 115 (1892), pp. 569–574*).—The fixation of atmospheric nitrogen by the agency of microbes in the soil has been established, but it has not been determined whether the substances enriched with the nitrogen constitute permanent components of the tissues of the microbes or whether they pass through these

tissues and are thereby modified in their composition, as is at present held with reference to the fixation of oxygen by the mycoderms of acetic fermentation. The question may be asked whether the microbes must exist in symbiosis with green plants, on the theory developed by Hellriegel and Wilfarth in their investigations on Leguminosæ, or whether the microbes have a separate existence, after the manner of a parasite, simply finding in the leguminous plant the conditions and the medium by which they are enabled to fix nitrogen in their peculiar tissues and to form the nitrogenous substances to be ultimately utilized in an independent way for the nutrition of the leguminous plants which serve for their momentary support.

To get some light which might aid in the solution of these interesting and complex problems, the author determined to provide the microbes with some nourishment more simple and better understood than vegetable mold. The materials chosen were a natural and an artificial humic acid. The former was obtained from a soil at Meudon which possessed the property of fixing nitrogen; the latter was prepared from sugar. The natural humic acid contained 3.61 per cent of nitrogen; the artificial acid was almost entirely without nitrogen or ash.

About 5 grams of the natural humic acid was put into a 6-liter flask filled with air. Then there was poured into the flask 5 c.c. of distilled water and 2 c.c. of water containing in suspension green plants of low orders developed at the bottom of a flask in ordinary water by exposure to a feeble light. The quantity of organic matter thus introduced was almost imponderable, but the liquid contained the germs of manifold living organisms, among which were certain forms capable of assimilating nitrogen. The flask was hermetically closed with a stopper of emery coated with vaseline. A second flask was prepared in a similar manner, except that 100 c.c. of the distilled water was used.

Into a third flask was put 5 grams of artificial humic acid, 15 c.c. of distilled water, and 2 c.c. of the liquid containing the germs. A fourth flask was prepared in a similar manner, except that 100 c.c. of the distilled water was used.

The four flasks were then exposed to diffused light without at any time receiving the direct rays of the sun. The experiment continued from June 30 to October 22, 1892, or about four months, at the temperature of the surrounding air.

In the four flasks there developed whitish microscopic plants of many species; at the same time there was formed a notable amount of carbonic acid, due to the action of the oxygen on the humic acid, partly from purely inorganic influences, as previously shown by the author, and partly, without doubt, through the agency of microbes. This formation of carbonic acid merits attention, for it is probably the intermediary by which the carbon was transferred from the humic acid to the plants developed in the flask.

The weight of the material in the first flask decreased from 4.725 to 4.681 grams. The difference was due to losses of carbonic acid and water, compensated in part by the oxygen fixed and also by the difficulty of recovering absolutely all of the material put into the flask. The gain of nitrogen is therefore estimated somewhat too low. The humic acid at the outset contained 0.1805 gram of nitrogen, but the amount of combined nitrogen found at the end of the experiment was 0.1909 gram, showing a gain of 0.0104 gram or 6 per cent.

In the second flask the material decreased in weight from 4.725 to 4.618 grams. The weight of the nitrogen at the beginning of the experiment was 0.1805 gram, and at its close 0.1961, showing a gain of 0.0156 gram or 9 per cent. In both cases, then, there was a gain of nitrogen after the humic material had served as food for microbes.

On treating with water a portion of the material left at the close of the experiment, it appeared that the aqueous extract contained no trace of nitrate, and only 0.12 milligram of ammoniacal nitrogen.

These experiments had been preceded by another, conducted from the autumn of 1891 to June, 1892, on 5 grams of this same natural humic acid kept in a moist condition in a large flask through which was passed several times a current of unpurified air containing dust from the neighboring soil. In this material there were developed mosses and various other kinds of plants, some green and others white. On analysis the total material was found to be 4.867 grams, the initial nitrogen 0.1805 gram, the final nitrogen 0.2350 gram—a gain in nitrogen of 0.0545 gram or 30.3 per cent. This larger gain than in the first-mentioned experiments was due either to the longer duration of the trial or to the more active nature of the numerous species of microbes which caused the fixation of the nitrogen.

Turning now to the experiments with the artificial humic acid, we find that in the third flask the total material recovered was 4.9735 grams, the initial nitrogen 0.001 gram, the final nitrogen 0.0036 gram—a gain of 0.0026 gram; in the fourth flask the total material recovered was 4.94 grams, the initial nitrogen 0.001 gram, the final nitrogen 0.0034 gram—a gain of 0.0024 gram. In both cases there had been fixation of nitrogen, which was very feeble, because without doubt the humic acid, devoid of nitrogen and ash, furnishes insufficient nutriment to the microbes.

Repeated analyses of the artificial humic acid showed that there was no fixation of nitrogen when the acid was simply exposed to chemical oxidation under the influence of air and light, thus confirming the testimony of the above-described experiments that the action of microbes is necessary to the fixation of nitrogen.

We are thus enabled to see that one of the organic substances in vegetable mold furnishes nourishment for microbes, and have advanced one step in the analysis of the phenomena associated with the fixation of nitrogen.—A. C. T.

On the fixation of free nitrogen by plants, T. SCHLÖSING, JR., and E. LAURENT (*Compt. rend., 115 (1892), pp. 732–738*).—A brief report

on experiments in continuation of those described in *Comptes rendus*, 111 (1890), p. 750, and 113 (1891), pp. 776–779 (E. S. R., vol. III, pp. 116 and 551). In preceding investigations the authors have shown that fixation of the free nitrogen of the air occurs in green plants of low orders and in the soil on which these plants are growing. The plants with which these earlier inquiries were made were a mixture of mosses, algæ, and bacteria. In the experiments reported in this article less complex cultures were used and the species of the plants were determined. Both the "direct" and "indirect" methods of determining the acquisition of nitrogen were employed, as described in the reports of previous experiments. The cultures were made on 600 grams of soil in each case.

Summary of experiments on the fixation of free nitrogen by plants.

Cultures.	Duration of experiment.	Direct method. Gaseous nitrogen				Indirect method. Nitrogen			Nitrogen in the plants.	Vegetable matter formed.	
		Initial	Final.	Gain or loss		Initial.	Final.	Gain or loss		Weight.	Per cent of nitrogen
Subsoil of Montretout and a small quantity of a diluted mixture of several soils											
1. A mixture of *Nostoc punctiforme* and *N. minutum*	*Mos.* 6	*C. c.* 982.9	*C. c.* 931.2	*C. c.* –51.7	*Mg.* –65.0	*Mg.* 73.5	*Mg.* 78.3*, 57.8† 136.1	*Mg.* 62.6	*Mg.* 69.3	*Mg.* 1,476	4.7
2. A mixture of *Nostoc punctiforme* and *N. minutum*	6	847.1	817	–29.5	–37.1	73.5	57.1*, 57.7† 114.8	41.3	47.7	1,148	4.2
Quartz sand almost devoid of nitrogen, treated as above.											
3. *Nostoc punctiforme*, almost pure	5	104.7	1,017.8	–29.2	–36.8	1.0	33.2*, 3.0† 36.2	35.2	32.8	827	4.0
4. *Nostoc punctiforme*, less pure	5	......	......	......	......	1.0	30.4*, 3.6† 34.0	33.0	29.7	543	5.5
Subsoil of Montretout											
5. Two mosses (*Brachythecium rutabulum* and *Barbula muralis*)‡	3	1,069.5	1,069.4	– 0.1	– 0.1	68.4	17.0*, 51.0† 68.0	– 0.4	10.4	193	5.4
6. An Oscillaria (*Microcoleus vaginatus*) almost pure§	3	781.5	785.1	0.3	0.4	66.4	17.7*, 48.8† 66.5	0.1	12.8	333	3.8
7. A few traces of algæ of little importance	9	740.3	739.8	– 0.5	– 0.6	66.4	67.5	1.1	.....	.....	.....
8. A few traces of algæ of little importance	9	580.1	578.7	– 1.4	– 1.8	.....	.....	.....	.....	.....	.....

* In the surface soil, 2–4 mm. deep.
† In all the soil below the surface soil above mentioned.
‡ Obtained by transplanting little isolated tufts, which afterward grew together.
§ Obtained by sowing on the soil a small quantity of algous material diluted with distilled water.

In the first four cultures fixation of free nitrogen clearly occurred. In the culture containing only *Microcoleus vaginatus* (No. 6) there was apparently no fixation of nitrogen. It would not be surprising if this was due to a difference in the nature of the alga. In the cases (Nos. 7 and 8) where the soil was almost entirely bare of vegetation nitrogen was not fixed in any appreciable amount.

The "nitrogen in the plants" was found by subtracting from the total nitrogen in the surface layer containing soil and plants the nitrogen found in an equal weight of subjacent soil. The weight of the vegetable matter formed was also determined. From these data the per cent of nitrogen in the dry plants was calculated and found to be about 4 or 5 per cent.

The fundamental fact ascertained in the authors' previous investigation was confirmed, viz, that fixation of nitrogen occurs in the tissues of plants of lower orders developed on the surface of soils. Chlorophyll action supplies the energy necessary to bring about the combination of free nitrogen.

The authors contend that the fixation of free nitrogen does not take place, as claimed by Berthelot, in the interior of the soil under the action of microbes. In the discussion which followed the reading of this paper Berthelot asserted that his investigations show that the green algæ are not the only microörganisms having the function of fixing atmospheric nitrogen, but that fixation also occurs under the influence of colorless inferior organisms which seem to be devoid of chlorophyll. It is possible that the origin of these phenomena will be found in still lower organisms, such as may develop in the root tubercles of leguminous plants and in other organisms devoid of chlorophyll. Berthelot is pursuing researches with reference to the existence of such organisms.—A. C. T.

On the gas exchanges of the root tubercles of leguminous plants, B. FRANK (*Ber. deut. bot. Ges., 10, pp. 271-281, plate 1*).—Previous investigations of the root tubercles of leguminous plants have indicated that they are covered with a corky epidermis, which prevents the interchange of fluids and gases between the tubercles and the surrounding world. The author's observations, reported and illustrated in this article, show that the corky covering of the root tubercles, especially those of peas, has intercellular air passages which communicate with the outer air, as is the case with lenticels. The system of air passages penetrates through the corky layer to the meristem. The meristem has no air passages, but these occur again in the bacteroid tissues below the meristem. To determine whether the gas within the tubercles came from the soil or was given off from the cells of the tubercles the author grew peas in water without the addition of nitrogen compounds or with a little pea soil for inoculation. Although the roots were never in contact with air, yet the tubercles which developed showed the structure described above. The gas in the intercellular passages in the tubercles must, in this case at least, have been derived from the tubercles themselves. The epidermal air passages when once established may serve for the transmission of air from without, but those in the bacteroid tissue can not do so, as they are shut off from all communication with the outside world. The origin of the gas within the tubercles may be found in the

carbonic acid gas, a common product of respiration, or in the water absorbed by the plants, from which atmospheric gases are released and recombined in the processes of growth. Observations are briefly reported which indicate that this gas is neither carbonic acid nor oxygen alone, but that it is rich in nitrogen. To investigate the gas exchanges in living root tubercles, a considerable number of root tubercles were cut from plants grown outdoors in garden soil and were inclosed in glass tubes with a known volume of air above quicksilver. A lively evolution of gas at once began and continued during the several days over which the experiment extended. The results, reported in tables, showed that nitrogen and carbonic acid gas had been evolved. The author, however, thinks that the evolution of these gases was not a normal process of the living tubercle, but a sign of decay. The gas exchange in the tubes was relatively small at first and increased as the experiment continued. Certain nitrogenous compounds which are common products of decay were formed. The air from the tubes in which the tubercles were confined contained ammonia, skatol, and indol. It also had the odor of a dead body. Carbonic acid was formed at first probably as a respiration product, but later as the result of decay.

These investigations indicate that the root tubercles of leguminous plants are sensitive organs which continue their normal activity only while united with the plant. If they are separated from the plant, even without being themselves mutilated in any way, in a few hours there is a complete change in their activity, especially in respect to the organic nitrogen compounds, which are broken up. The nitrogen in these compounds returns to its elementary condition and escapes. It follows that it is not practicable to determine the normal processes occurring in the tubercles by experimenting with them apart from the plants. The metabolism of the tubercles in union with the plant must be different from that of the isolated tubercles. It is possible that the tubercles when united with the plant absorb nitrogen directly, but direct observations immediately after the separation of the tubercles do not give any testimony on this point because of the speedy revolution in the activity of these organs.—A. C. T.

The horn fly, J. FLETCHER (*Canada Central Experimental Farm Bul. No. 14, Sept., 1892, pp. 11, figs. 2*).—A brief account of *Hæmatobia serrata*, compiled from reports of investigations in the United States, with suggestions as to means of repression. This insect has appeared in Canada and has already caused considerable trouble there.—A. C. T.

Analysis of the Cavendish banana in relation to its value as food, W. M. DOHERTY (*Chem. News, 66 (1892), pp. 187, 188*).—The author has analyzed the pulp of *Muca cavendishii*, the dwarf banana, with the following results:

Analysis of banana pulp.

	In fresh substance.	In dry matter.
	Per cent.	*Per cent.*
Water	75 71	....
Albuminoids	1.71	7 05
Starch	5 90	24.78
Sugar	3 00	12 35
Carbonaceous matter	11.24	47.05
Woody fiber	1.74	7.26
Ash	0.71	2.92

Composition of the ash.

	Per cent.
Potassium oxide	55.10
Sodium oxide	12 00
Calcium oxide	1.61
Magnesium oxide	5.41
Ferric oxide	0 48
Manganese dioxide	0.15
Phosphoric acid	7 70
Sulphuric acid	1.80
Carbonic acid	12.00
Chlorine	1.10
Silica	1 96
Loss, etc	0.69
	100.00

In nutritive properties the Cavendish banana resembles the potato.—E. W. A.

Feeding experiments with sunflower-seed cake for milch cows, J. KLEIN (*Milch Ztg., 1892, pp. 673–677*).—Sunflower-seed cake is said to have found quite extensive use for feeding within the last few years, especially in Denmark. A trial is reported with four cows, made to compare the effects of sunflower-seed cake and linseed cake. The sunflower-seed cake was fed in the form of meal and was of the following composition: Dry matter 91.32, crude protein 36.73, crude fat 13.94, carbohydrates 20.60, crude fiber 15.68, and crude ash 4.37 per cent. On the basis of Wolff's tables of digestibility it contained, therefore, 30.9 per cent of digestible albuminoids, 12.5 per cent of digestible fat, and 25 per cent of digestible carbohydrates.

There were four lots of four cows each. The first lot received the winter ration which all the cows had received previous to the trial, consisting of distillery slop, brewers' grains, linseed cake, meadow hay, and other coarse fodder, with a nutritive ratio of 1: 6.5. In addition to this ration lot 2 received 1 pound and lot 3, 2 pounds per head per day of sunflower-seed cake, and lot 4, 1 pound each of sunflower-seed cake and linseed cake. The nutritive ratios of the rations of the four lots were therefore, lot 1, 1:65; lot 2, 1:5.8; lot 3, 1:5.3; and lot 4, 1:5.4. The cows of the four lots averaged very nearly the same period of lactation.

The trial lasted from February 22 to April 12. During the first week all four lots received the basal ration. The second, third, and fourth

weeks the concentrated foods were added to the rations of lots 2, 3, and 4; and the fifth, sixth, and seventh weeks the basal ration was fed again. The cows were milked twice daily, the quantity being determined by weight at each milking, and samples of the milk of each animal were analyzed two or three times each week. The changes of food were made gradually.

A summary of the results of the feeding experiments shows that the addition of sunflower-seed cake to the basal ration was accompanied in the case of every cow by an increased milk yield. In this connection the addition of 1 pound of the cake appeared to be practically as effective as the addition of 2 pounds, which the author attributes to the period not being sufficiently long to show the full effects of the addition of 2 pounds. Sunflower-seed cake seemed to be fully as effective as linseed cake. The sunflower-seed cake apparently had no effect on either the fat content of the milk or the live weight of the animals. Financially there was no advantage from the addition of either the sunflower-seed cake or linseed cake to the basal ration. The additional yield of 0.7 liter of milk per day with 1 pound of sunflower-seed cake was produced at a cost of nearly 2½ cents.—E. W. A.

Effects of different kinds of food on the volatile fatty acids and the melting point of butter, ADOLF MAYER (*Landw. Vers. Stat., 41, pp. 11-35*).—The author prefaces the description of his present experiments with a review of the conclusions from his previous experiments on this subject, published in 1888.* These are as follows:

(1) The percentage of volatile fatty acids and the specific gravity of butter fat go hand in hand. An increase of the one results in an increase of the other.

(2) The melting point of butter fat does not vary proportionally with these, as it is presumably more especially influenced by the olein content.

(3) The percentage of volatile fatty acids and the specific gravity of butter fat from a single cow vary more widely under different methods of feeding than has usually been supposed.

(4) The volatile fatty acids are dependent upon the period of lactation, the percentage decreasing, as a rule, as the period advances (confirmed by Nilson).

(5) But they are also dependent to a large extent on the character of the food (which is in opposition to Nilson). A higher percentage of volatile fatty acids was produced on roots, meadow grass, and green clover than on hay, and a higher percentage with the latter than with ensiled grass.

(6) The melting point of butter is likewise dependent upon the food. Ensiled grass and hay gave butter with the highest melting point, and roots the next highest, while exclusive feeding on green food, whether grass or clover, in the barn or at pasture, resulted in butter with the lowest melting point.

*Landw. Vers. Stat., 35, pp. 260-282.

(7) As a rule the point of crystallization fluctuates with the melting point.

(8) In the case of animals accustomed to it, pasturage has a very good effect on the yield of milk and butter.

This line of investigation has been continued, and the results obtained form the basis of the present paper. From August 25 to February 25 a North Holland cow, nine and one half years old and about two months with calf at the beginning of the trial, was fed a wide range of foods in periods of twelve days each, determinations being made twice in each period of the specific gravity, solids, and fat (the latter by calculation) of the mixed morning's and night's milk and of the melting point and volatile fatty acids of the butter. The latter were determined by the Reichert-Wollny method, and expressed in terms of the cubic centimeters of soda solution required to neutralize 5 grams of butter fat. The foods given in different periods included meadow grass *ad libitum*; 15 kg. hay and 2 kg. linseed cake, alone or with 50 c. c. concentrated lactic acid or 100 c. c. of volatile fatty acids from a stearin factory; 10 kg. hay and 2 kg. linseed cake; 10 kg. pea vines and 5 kg. rye straw, with either 4 kg. sesame cake or 4 kg. linseed cake; 5 kg. pea vines, 10 kg. rye straw, and 3 kg. peanut cake; 15 kg. pea vines and 4 kg. rye; 40 kg. ensiled sugar beet residue, 5 kg. rye straw, and 4 kg. linseed cake; 10 kg. corn silage, 8 kg. rye straw, and 4 kg. linseed cake; and 11 kg. pea vines, 5 kg. rye straw, and 4 kg. poppy cake. At the conclusion of this feeding the milk yield had fallen to 3½ liters a day, and the feeding was continued for four months in much the same manner with another cow fresh in milk. In both trials certain of the rations were repeated at different stages of the trial, with a view to eliminating error from advancing lactation as far as possible.

In the case of the first cow the volatile fatty acids in the butter varied on different food from 13.4 to 24.9 c. c., and of the second cow from 20.1 to 32.2 c. c. While these variations are not quite as large as those observed in the former experiments, alluded to above, it is believed they indicate that in the case of the same cow the volatile fatty acids may show a wide range of variation on different rations, and the rations fed do not, of course, cover the whole range of rations fed in practice. The author urges from this that the judgment of the purity of butter on the basis of the volatile fatty acids may lead to gross injustice, by implicating honest dairymen who have made an unfortunate selection of feeding stuffs. He states, for instance, that the feeding of poppy cake and pea vines proved disastrous to the high content of volatile fatty acids, giving butter near the end of the period of lactation with volatile acids equivalent to only 13.5 c. c. of soda solution. In Holland the minimum limit is 19 c. c., but the danger from reducing the standard is that artificial butters will not be excluded. For this reason the author thinks that critical judgment of butter should be based on a number of different tests.

The following statement shows the feeding stuffs which were tested, arranged in the order in which they increased the volatile fatty acids, those effecting the greatest increase being placed first:

Coarse fodders.	*Concentrated foods.*
Red beets.	Rye.
Meadow grass in spring.	"Maize-sprout cake."
Green clover.	Cotton-seed meal cake.
Meadow grass in field.	Peanut cake.
Hay, corn silage.	Sesame cake.
Ensiled grass.	Linseed cake.
Straw.	Poppy cake.

The addition to the food of lactic acid or of volatile fatty acids in the amounts in which they could be given showed no effect on the volatile fatty acids in the butter. The author criticises the investigations of Schrodt and Henzold,* claiming that instead of testing the effects of a large number of rations, practically only two rations were tested, viz, pasturage in summer and a mixture of hay, straw, beets, wheat bran, and cotton-seed-meal cake in winter; and that from his own investigations it might be expected that the volatile fatty acids on the winter ration fed would not be materially different from those on pasturage. The winter ration contained a small amount of straw, which, as indicated by the author's tests, decreases the volatile fatty acids, and two feeding stuffs, which, according to his trials, strongly tend to increase these acids. He believes that this explains the reason why the winter ration gave results agreeing with those on pasture grass.

The author's results afford considerable support to the hypothesis that a ration rich in soluble carbohydrates results in butter with a high content of volatile fatty acids. As an instance of this he cites the effect of beets as compared with hay; the former, containing much more sugar than the latter, increased the volatile fatty acids to a greater extent. He also compares the effect of fresh grass and green fodders with hay and silage in which the sugars have been largely dispelled by fermentation. Furthermore, he compares rye grain and maize-sprout cake, both of which are rich in digestible starch and had a favorable influence on the volatile fatty acids, with poppy cake, which is poorest of all the feeding cakes in carbohydrates, and with linseed cake, which at least contains no starch meal. Both the poppy cake and the linseed cake affected the fatty acids unfavorably.

The author traces no connection between the fat in the food and that in the butter further than that the feeding of considerable amounts of non-volatile fatty acids do not appear to increase the volatile fatty acids of the butter. This last result agrees with the experience of Weiske and Soxhlet, according to which the volatile fatty acids of the food, including butyric acid, are not transmitted to the butter.

*E. S. R., vol. IV, pp. 92-95.

Concerning the melting point of the butter, the experiments above reported are believed to show that both this and the point of crystallization diminish somewhat as the period of lactation advances, in case the food remains unchanged. The melting point and the point of crystallization are not always affected in exactly the same degree, but if the average of the two is taken it is found that the effect due to the period of lactation is very small. This average factor is therefore taken as a basis for studying the effect of food, leaving the stage of the period of lactation out of account. A very hard butter was produced by the mixture of pea vines and poppy cake, and likewise, although not in the same degree, by mixtures of straw with linseed cake or sesame cake, and (still less) with peanut cake. Cotton-seed-meal cake and rye grain gave softer butter than any of the above. Pasture grass gave a softer butter than the normal ration of hay and linseed cake. This last is a complete confirmation of the results obtained by the author on previous occasions. Straw appeared to have a very favorable effect on the consistency of the butter. The effect of ensiled grass and corn silage was about the same as that of hay, while beet diffusion residue was noticeably unfavorable to hardness. Maize-sprout cake was also unfavorable to hardness. The addition of lactic acid or of volatile fatty acids to the food was accompanied by a decreased melting point of the butter. Arranged in the order in which they favorably affected the hardness of the butter, the feeding stuffs used were as follows:

Coarse fodders	*Concentrated foods.*
Straw.	Poppy cake.
Hay, ensiled hay and maize silage.	Linseed cake. sesame cake.
Old pasture grass.	Peanut cake.
Beet diffusion residue.	Rye, cotton-seed meal.
Young grass.	Germinated maize cake.

It will be seen that this order is nearly the reverse of that in which the feeding stuffs increased the volatile fatty acids. In general then, butters with a relatively high content of volatile fatty acids had a relatively low melting point, and *vice versa*. This is only a general rule, to which there are some exceptions.

In continuing this line of investigations the author proposes to study along the line of the hypothesis indicated by the above investigation, that is, the effect of easily digestible carbohydrates in the food on the volatile fatty acids of the butter.—E. W. A.

Experiments in the feeding of swine, J. W. ROBERTSON (*Canada Central Experimental Farm Bul. No. 15, Oct., 1892, pp. 12*).

Raw vs. steamed food (pp. 3–5).—The account of this experiment is reprinted from the Annual Report of the Canadian Experimental Farms for 1891 (E. S. R., vol. IV, p. 441).

Feeding grain unground and ground with or without skim milk (pp. 5–7).—Four lots of pigs were used in this experiment with either four or five

pigs in each lot. All received a mixture of equal parts of peas, barley, and rye, but to lot 1 this mixture was fed unground and soaked in cold water for forty-eight hours. and to the remaining lots ground and soaked in water for twelve hours. In addition to the grain, lots 3 and 4 were given all the skim milk they would drink. The feeding continued for seventeen weeks. The summary of the results follows:

Summary of results of pig-feeding trials.

	Average weight per pig at beginning.	Gain in weight of lot.	Grain consumed per pound of gain.
	Pounds.	*Pounds.*	*Pounds.*
Lot 1, unground grain	69	434	4.45
Lot 2, ground grain	69	519	4.36
Lot 3, ground grain and skim milk	69	671	2.46
Lot 4, ground grain and skim milk	76	536	3.46

There is little if any apparent difference between the lots fed whole grain and ground grain. "One pound of grain was the equivalent of 6.65 pounds of skim milk in increasing the live weight. The swine which were fed upon a ration containing skim milk were lustier and more robust in appearance than those which were fed upon grain only."

Feeding frozen wheat (pp. 7–12).—The value of frozen grain for pigs was tested in two separate trials. The first trial included three lots of four pigs each. Lot 1 received frozen wheat ground and soaked for twelve hours; lot 2, frozen wheat unground, soaked for forty-two hours; and lot 3, a mixture of equal parts of wheat, barley, and peas, unground and soaked for forty-two hours. The pigs averaged 186 pounds each at the commencement of the trial. The trial lasted from December 28 to March 14. The result was very favorable to the frozen wheat, and especially so where fed ground.

In the second trial two lots were used, one averaging 61 pounds per pig and the other 104 pounds. Both lots were given ground frozen wheat soaked for twelve hours, and lot 2 received skim milk in addition. "During the last three weeks of the test [lot 1] were fed upon the lowest quality of frozen wheat only, which had been graded 'unmarketable.'" The trial lasted from February 1 to May 30. The results were as follows:

(1) When the frozen wheat was fed ground and soaked for twelve hours, 14.18 pounds of increase in the live weight was obtained per bushel of wheat.

(2) In the feeding of swine from an average weight of 61 pounds each until they reached an average weight of 145 pounds each, 15.46 pounds of increase in the live weight was obtained per bushel of wheat.

(3) One pound of frozen wheat was the equivalent of 7.91 pounds of skim milk in increasing the live weight.

(4) The swine which were fed upon a ration containing skim milk were lustier and more robust in appearance than those which were fed upon grain only.

The pigs were slaughtered and parts of the pork cooked. The pork was pronounced excellent and superior to that of pigs fed exclusively on peas. "When the frozen wheat is to be fed unground it should be soaked for at least twenty-four hours."—E. W. A.

Amyloid, a new constituent of milk and dairy products, F. J. HERZ (*Chem. Ztg., 1892, pp. 1524, 1525*).—The author reports finding by microscopic examinations of butter, hard and soft cheese, and "a chemically pure" preparation of casein, bodies which in size, form, and behavior toward iodine closely resembled starch. They differed from the latter, however, by not being affected by boiling water, hot alcohol, or ether. Those found in milk were round or egg-shaped, resembling vegetable starch, and from 10 to 35 micromillimeters in diameter, while those in butter, cheese, and casein were of irregular outline, colored irregularly with iodine, and were much larger, being in some instances 115 micromillimeters in length. These bodies were noticed in various samples of milk, in the ether solution of fat, in the udder of a cow which had suffered from milk fever, and in the colostrum from the same cow. They are not numerous in the microscopic field, occurring singly or two or three together, and are found by searching through the casein particles colored yellow or brownish by iodine.

The author refers to the finding of an amyloid substance by Virchow in the spleen, liver, kidneys, etc., and is inclined to believe that the material which he finds in milk and dairy products is of similar nature. He suggests that it might perhaps be prepared in pure state from milk or colostrum by pepsin-hydrochloric acid. Whether or not these amyloid bodies always occur in milk and whether they have any importance in connection with the manufacture of milk products are questions for future study.—E. W. A.

Investigations of sheep's milk, C. BESANA (*Chem. Ztg., 1892, pp. 1519, 1551, and 1598*).—These investigations were made at the Agricultural School at Rome, where during the past winter a course was given on cheese-making from sheep's milk. The sheep used were of the "Sopravissana" breed, the common breed of that country. The milk yield of this breed is given as from 45 to 50 liters per year, and the average yield per head and per day 250 to 300 c. c. The maximum yield noticed was 805 c. c. (nearly a quart) in the case of a sheep twenty-one days advanced in the milking period. The specific gravity of the milk ranged from 1.037 to 1.043 at 15° C. An average of one hundred and seventy-six determinations gave 1.0395.

The lactodensimeter used with cows' milk is said not to be adapted to sheep's milk, which requires an instrument graduated from 1.026 to 1.043. Sheep's milk being richer than cows' milk shows a greater fluctuation in the specific gravity at different temperatures, so that the corrections for temperature can not be made from the ordinary tables for cows' milk. The author gives a table for correcting the specific gravity of sheep's milk for 15° C. The average composition of a

number of samples of sheep's milk analyzed by the author and his assistants is given as follows:

Average composition of sheep's milk.

	Per cent.
Water	78.23
Total solids	21.77
Fat	9.50
Protein	6.26
Milk sugar	5.00
Ash	1.01

Specific gravity at 15° C., 1.0378.

Owing to its richness in fat, sheep's milk under the microscope shows a crowded mass of fat globules, and must be diluted in order to compare it with cows' milk. The fat globules are much larger than those of cows' milk. The largest globule found in sheep's milk measured 0.0309 mm. in diameter, or nearly three times that of the largest globules found in cows' milk. A majority of the globules were much smaller than this. The larger globules of sheep's milk are not quite round. With the aid of a microscope and a micrometer, therefore, it can be seen whether cows' milk is mixed with sheep's milk, or whether sheep's milk is diluted with water, to be sold as cows' milk—a practice which is not uncommon in some regions. Owing to the thickness and viscosity of sheep's milk, the fat globules do not rise rapidly in creaming. At the end of twenty-four hours' setting no sharp layer of cream was to be seen, although the upper layer was found to be richer in fat. In using the creamometer, the author dilutes the milk with an equal volume of water and allows the cream to rise for forty-eight hours.

The viscosity of sheep's milk was found to vary somewhat in different samples. It seemed to depend principally upon the casein, for after this had been coagulated by rennet the viscosity was much lower and the fat globules present rose to the surface quite rapidly.

The spontaneous souring of sheep's milk seemed to take place more slowly than in the case of cows' milk. Two samples of milk, 1 of sheep's milk and 1 of cows' milk, were kept in a room together at a temperature between 10 and 12° C. The cows' milk was thick with coagulated casein at the end of six days and the sheep's milk at the end of fourteen days. The reason for this difference is unknown.

Under corresponding circumstances much more rennet is required for curdling sheep's milk than cows' milk. Where equal quantities of milk were treated at 35° C. with like quantities of rennet solution, from one and one half to two times as long was required for curdling the sheep's milk as for the cows' milk.—E. W. A.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

Further observations on amyloid (*Neues über die Amyloidsubstanz*), N. P. KRAWKOW.—*Centralbl. med. Wissensch., 1892, pp. 145–148; abs. in Centralbl. agr. Chem., 21, Heft 11, pp. 753, 754.*

Daturic acid, a new fatty acid obtained from the oil of Datura stramonium (*Sur un nouvel acide gras retiré de l'huile de Datura stramonium. l'acide daturique*), E. GÉRARD.—*Ann. Chim. et Phys., 27 (1892), ser. 6, Dec., pp. 549–566.*

On the non-crystallizable products of the action of diastase on starch (*Ueber die nicht krystallisirbaren Produkte der Einwirkung der Diastase auf Stärke*), A. SCHIFFERER.—*Inaug. Diss., Kiel, 1892; abs. in Chem. Ztg., 1892, Repert., p. 336.*

The determination of phosphoric acid in basic slag, A. FIRBY.—*Chem. News, 66 (1892), p. 293.*

Determination of potash by the Lindo-Gladding method (*Die Kalibestimmung nach der methode Lindo-Gladding*), A. F. HOLLEMAN.—*Chem. Ztg., 1892, No. 102, pp. 1920. 1921.*

The reaction of sodium acetate (*Ueber die Reaction des Natrium-acetates*), F. COLLISCHONN.—*Chem. Ztg., 1892, No. 102, pp. 1921, 1922.*

Determination of sugar by Fehling's method (*Zur Bestimmung des Zuckers nach der Fehling'schen Methode*), F. SEIDEL.—*Schweiz. Wochensch. Chem. u. Pharm., 30 (1892), p. 434; abs. in Chem. Centralbl., 1892, II, No. 25, p. 1051.*

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Contribution to qualitative and quantitative examination of wax (*Beiträge zur qualitativen und quantitativen Wachsuntersuchung*), H. RÖTTGER.—*Chem. Ztg., 1892, No. 98, pp. 1837–1839.*

Examination of waxes by the Hübl method (*Zur Wachsuntersuchung nach Hübl*), G. BUCHNER.—*Chem. Ztg., 1892, No. 102, p. 1922.*

A criticism on the official methods of the Association of Official Agricultural Chemists (*Falsche. aber officielle handelsanalytische Methoden in den Vereinigten Staaten*), T. BREYER and H. SCHWEITZER.—*Chem. Ztg., 1892, No. 92, pp. 1720–1723.*

A pipette and burette for industrial purposes, G. A. LE ROY.—*Monit. scientif., 1892, ser. 4, pp. 719–722; abs. in Chem. Centralbl., 1892, II, No. 24, p. 991.*

Apparatus for titration with automatic attachment for filling burettes to zero point (*Titrierapparat mit automatischer Einstellung des Nullpunktes*), S. KRAWCZYNSKI.—*Ber. deut. chem. Ges., 25, p. 3010; abs. in Chem. Centralbl., 1892, II, No. 24, p. 991.*

Æcidiconium, a new genus of Uredineæ (*Æcidiconium, genre nouveau d'Urédinées*), P. VUILLEMIN.—*Compt. rend., 115 (1892), No. 22, pp. 966–969.*

On the nature and importance of the physiological elements of protoplasm (*Ueber die Natur und Bedeutung der physiologischen Elemente des Protoplasmas*), W. DETMER.—*Ber. deut. bot. Ges., 10, pp. 433–441.*

Sieve-pores in the tracheal wood-elements of Phanerogams, especially Leguminosæ (*Siebähnliche Poren in den trachealen Xylemelementen der Phanerogamen, hauptsächlich der Leguminosen*), B. JÖNSSON.—*Ber. deut. bot. Ges., 10, pp. 494–513.*

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The decomposition of albuminoids in plants in the absence of free oxygen (*Der Eiweisszerfall in der Pflanze bei Abwesenheit des freien Sauerstoffs*), W. DETMER.—*Ber. deut. bot. Ges., 10, pp. 442–446.*

The exchanges of carbonic acid and oxygen between plants and the atmosphere (*Sur les échanges d'acide carbonique et d'oxy gèneentre les plantes et l'atmosphère*), T. SCHLÖSING, JR.—*Compt. rend., 115 (1892), No. 23, pp. 1017–1020.*

Assimilation of atmospheric nitrogen by leguminous and non-leguminous plants (*Ein Beitrag zur Stickstofffrage*), LIEBSCHER.—*Deut. landw. Presse, 1892, No. 104, pp. 1080, 1081.*

Observations on the normal respiration of plants (*Beobachtungen über die normale Athmung der Pflanzen*), W. DETMER.—*Ber. deut. bot. Ges., 10, pp. 535–539.*

The modifications of absorption and transpiration in plants touched by frost (*Sur les modifications de l'absorption et de la transpiration qui surviennent dans les plantes atteintes par la gelée*), A. PRUNET.—*Compt. rend., 115 (1892), No. 22, pp. 964–966.*

Differences in the transmissibility of pressure through woody, herbaceous, and soft plants (*Sur la différence de transmissibilité des pressions à travers les plantes ligneuses, les plantes herbacées, et les plantes grasses*), G. BONNIER.—*Compt. rend., 115 (1892), No. 24, pp. 1097–1100.*

Contributions to the biology of the bud (*Beiträge zur Biologie der Knospe*), J. GRÜSS.—*Jahrb. wiss. Bot., 23 (1892), p. 637; abs. in Naturwiss. Rundschau, 7 (1892), No. 47, pp. 604, 605.*

Reply to Frank regarding the dimorphism of the root tubercles of peas (*Entgegnung gegen Frank, betreffend den angeblichen Dimorphismus der Wurzelknöllchen der Erbse*), H. MOELLER.—*Ber. deut. bot. Ges., 10, pp. 568–570.*

A method for preserving the vitality of plants transported from distant tropical regions (*Méthode pour assurer la conservation de la vitalité des plantes provenant des régions tropicales lointanes*), M. CORNU.—*Compt. rend., 115 (1892), No. 24, pp. 1094–1097.*

Relation between the production of alcohol and the increased growth of the yeast during fermentation (*Ueber das Verhältniss in welchem sich Alkohol und Hefe während der Gährung bilden*), E. MACH and K. PORTELE.—*Landw. Vers. Stat., 41, Heft 4, pp. 261–263.*

Investigations with pure cultures of yeasts, I (*Untersuchungen über reine Hefen, I Theil*), J. WORTMANN.—*Landw. Jahrb., 21 (1892), pp. 901–936.*

The fermentation of grape and apple must with pure cultures of various organisms (*Ueber die Gährung von Trauben- und Aepfelmost mit verschiedenen reingezüchteten Hefearten*), E. MACH and K. PORTELE.—*Landw. Vers. Stat., 41, Heft 4, pp. 233–260.*

The present condition of our knowledge of the bacteriology of water, P. F. FRANKLAND and M. WARD.—*Proc. Royal Soc., 51 (1892), No. 310, p. 183.*

On the measurement of the permeability of soils and the determination of the number and surface area of the particles contained in 1 c. c. of soil (*Sur la mesure de la perméabilité des sols et la détermination du nombre et de la surface des particles contenues dans 1 c. c. du sol*), F. HOUDAILLE and L. SEMICHON.—*Compt. rend., 115 (1892), No. 23, pp. 1015–1017.*

Effect of pressure of carbonic acid in the soil on vegetation (*Einfluss des Kohlensäure-Druckes im Boden auf die Vegetation*), S. JENTIS.—*Anzeig. Akad. Krakau, 1892, p. 306; abs in Naturwiss. Rundschau, 7 (1892), No. 47, p. 608.*

Substances in moor soils injurious to vegetation (*Ueber die pflanzenschädlichen Stoffe im Moorboden*), B. TACKE.—*Mitt. Ver. Förd. Moorkultur im deut. Reich, 1892, p. 46; abs. in Centralbl. agr. Chem., 21, Heft 11, pp. 729–731.*

Elements of manuring and agricultural statistics (*Leitfaden der gesammten Düngerlehre und Statistik des Landbaues*), G. HEIDEN.—Third edition, revised by H. Gräfe. Hanover, Phil. Cohen, 1892, 80 cents.

The preparation of manure (*Étude sur la préparation du fumier*), A. HÉBERT.—*Ann. Agron., 18 (1892), No. 11, pp. 536–550.*

Contributions to the nitrogen question (*Beiträge zur Stickstofffrage*), A. PETERMANN.—*Abs. in Chem. Centralbl., 1892, II, No. 20, pp. 880, 881.*

Ammonium sulphate as a fertilizer (*Das schwefelsäure Ammoniak als Düngemittel*), P. WAGNER.—*Jour. Gasbeleuchtung u. Wasserversorgung, 35, pp. 601–603; abs. in Chem. Centralbl., 1892, II, No. 24, p. 985.*

Effect of fineness and content of fat and gelatinous substances of ground bone on its action as a fertilizer (*Ueber den Einfluss des Feinheitsgrades, sowie des Gehaltes des Knochenmehles an Fett und leimgebender Substanz auf dessen düngende Wirkung*), ULBRICHT.—*Der Landbote, 1892, pp. 78, 79; abs. in Centralbl. agr. Chem., 21, Heft 11, p. 778.*

On the formation and loss of ammonia in the decay of animal excreta, E. JENTYS.—*Bul. Acad. Sci. Cracovie, 1891; abs. in Centralbl. agr. Chem., 21, Heft 11, pp. 745–747.*

Further observations on the value of street and house sweepings as a fertilizer (*Ueber den Düngewert von Strassen und Hauskehricht*), J. H. VOGEL.—*Deut. landw. Presse, 1892, No. 102, p. 1056.*

On manuring with lime (*Ueber Kalkdüngung*), A. MORGEN.—*Zeitsch. landw. Cent. Ver. Sachsen, 1892, No. 11, pp. 377–380.*

The occurrence of spurious and inferior Thomas slag meal (*Ueber das Vorkommen von unächtem und minderwerthigem Thomasphosphatmehl*).—*Landw. Wochenbl. Schleswig-Holstein, 1892, pp. 414–416.*

The yield of oats as influenced by manuring (*Abhängigkeit des Hafererträges von der Düngung*), A. LEYDHECKER.—*Oesterr. landw. Wochenbl., 1892, No. 24, pp. 186, 187; abs. in Centralbl. agr. Chem., 21, Heft 11, pp. 744, 745.*

Fertilizer experiments with rice (*Düngungs-Versuche mit Reis*), O. KELLNER, Y. KOZAI, Y. MORI, and M. NAGAOKA.—*Landw. Vers. Stat., 41, Heft 4, pp. 295–328.*

Effect of phosphoric-acid manuring on the sugar content of sugar beets (*Einfluss der phosphorsäuredüngung auf den Zuckergehalt und fabrikativen Werth der Zuckerrüben*), M. MAERCKER.—*Braunschwg. landw. Ztg., 1892, p. 191.*

Composition of a number of varieties of apples and pears (*Ueber die Zusammensetzung einer Anzahl Aepfel und Birnsorten aus dem Anstaltsgute*), E. MACH and K. PORTELE.—*Landw. Vers. Stat., 41, Heft 4, pp. 283–294.*

Investigations of the ripening of the apple, especially after picking (*Untersuchungen über das Nachreifen der Aepfel*), P. KULISCH.—*Landw. Jahrb., 21 (1892), Heft 6, pp. 871–886.*

On canker in apple trees (*Zum Krebs der Apfelbäume*), N. LAPINE.—*Landw. Jahrb., 21 (1892), Heft 6, pp. 936–949.*

Effect of inorganic salts and acids on the vitality of the germs of some parasitic fungi (*Ueber die Einwirkung von Metallsalzen und Säuren auf die Keimfähigkeit der sporen einiger parasitischer Pilze*), E. WÜTHRICH.—*Abs. in Fühling's landw. Ztg., 1892, Heft 23, p. 870.*

The use of carbolic acid in combating root blight on sugar beets (*Ueber die Anwendung von Carbolsäure zur Bekämpfung des Wurzelbrandes der Zuckerrübe*), A. STIFT.—*Oesterr. landw. Wochenbl., 1892, No. 51, p. 404.*

Investigations on the colors of insects (*Recherches sur les couleurs de quelques insects*), A. B. GRIFFITHS.—*Compt. rend., 115 (1892), No. 22, pp. 958, 959.*

Composition of the ash of Hungarian molasses (*Zusammensetzung der Asche der ungarischen Melasse*), J. SZILÁGE.—*Chem. Ztg., 1892, No. 102, p. 1922.*

Notes on digestion of starch.—*Pharm. Jour. and Trans., 23, p. 187; abs. in Chem. Ztg., 1892, Repert., p. 298, and in Chem. Centralbl., 1892, II, No. 25, p. 1025.*

Dried potato pulp from starch factories as a feeding stuff (*Getrocknete Kartoffelpulpe*).—*Landw. Centralbl. Prov. Posen, 1892, p. 311.*

Methods for decreasing the pathogenic influence of ensiled beet pulp (*Des moyens de deminuer le pouvoir pathogène des pulpes de betteraves ensilées*), ARLOING.—*Compt. rend, 115 (1892), No. 24, pp. 1045–1048.*

Further observations on the losses in drying brewers' grains (*Trockene Biertreber*), A. STUTZER.—*Zeitsch. angew. Chem., 1892, pp. 636–639; abs. in Chem. Centralbl., 1892, II, No. 24, pp. 985, 986.*

Digestibility of albuminoids of raw and cooked meat (*Die Verdaulichkeit der Eiweissstoffe*), A. STUTZER.—*Centralbl. allg. Gesundheitspflege, 11, p. 59; abs. in Vierteljahressch. Chem. Nahrungs- u. Genussmtl., 7, p. 124, and in Chem. Centralbl., 1892, II, No. 25, pp. 1026, 1027.*

Feeding experiments with isomaltose, dextromaltose, and rhamnose (*Fütterungsversuche mit neuen Zuckerarten*), CREMER.—*Centralbl. Physiol., 6, p. 396; abs. in Chem. Centralbl., 1892, II, No. 20, p. 884.*

Experiments in feeding ground meat to different kinds of animals, a résumé (*Versuche mit Fleischmehlfütterung*), M. BERNER.—*Fühling's landw. Ztg., 1892, Heft 23, pp. 836–841.*

Effect of food on the qualities of milk (*Einfluss der Fütterung auf die Beschaffenheit der Milch*), B. SCHULZE.—*Molk. Ztg., 1892, No. 17; abs. in Chem. Centralbl., 1892, II, No. 25, p. 1023.*

Effect of various combinations of feeding stuffs on the secretion of milk and on the assimilation of the food by milch cows (*Verschiedenartig zusammengesetzte Futterrationen in ihrer Wirkung auf die Milchsecretion und auf die Ausnutzung des Futters durch Milchkühes*), R. KOCHS and RAMM.—*Landw. Jahrb., 21 (1892), Heft 6, pp. 809–838.*

Transmission of substances from the food to the milk (*Ueber die Bedeutung der Milchmittel*), FRÖHNER.—*Zeitsch. Fleisch- u. Milch Hyg., 1, No. 10; abs. in Chem. Centralbl., 1892, I, p. 231, and in Centralbl. agr. Chem., 21, Heft 11, p. 782.*

Experience in inoculating cattle with tuberculin (*Ein Erfahrung mit der Impfung von Tuberculin*).—*Landw. Wochenbl. Schleswig-Holstein, 1892, pp. 417–419.*

On inoculation with tuberculin (*Zur Tuberkulin-Impfung*).—*Milch Ztg., 1892, No. 48, pp. 807, 808.*

The reaction of cows' milk (*Ueber die Reaktion der Kuhmilch*), J. SEBELIEN.—*Abs. in Vierteljahressch. Chem. Nahrungs- u. Genussmtl., 7, p. 127, and Chem. Centralbl., 1892, II, No. 25, p. 1024.*

Composition of colostrum from cows (*Beiträge zur Zusammensetzung des Kuhkolostrums*), KRÜGER.—*Molk. Ztg., 1892; abs. in Chem. Centralbl., 1892, II, No. 25, pp. 1023, 1024.*

Butter analysis (*Ueber Butteruntersuchungen*), H. KREIT.—*Schweiz. Wochenschr. Chem. u. Pharm., 1892, p. 449; abs. in Chem. Ztg., 1892, Repert., p. 351.*

Analysis of Caccio cavallo, an Italian cheese (*Analysen von Caccio cavallo*).—*Milch Ztg., 1892, No. 49, p. 823.*

Injurious effects of certain plants on milk and its products (*Schädliche Wirkung von Pflanzen auf die Milch und ihre Produkte*).—*Schweiz. landw. Zeitsch., 1892, Heft 41; abs. in Milch Ztg., 1892, No. 49, p. 825.*

Stringy milk and the means for its prevention, a résumé (*Ueber fadenziehende Milch und Mittel zu deren Vorbeugung*).—*Milch Ztg., 1892, No. 48, pp. 808, 809.*

On milk sterilization and bitter milk (*Ueber Milchsterilisation und bittere Milch*).—*Molk. Ztg., 1892, No. 49, p. 604.*

Microbicide action of carbonic acid in milk (*Action microbicide de l'acide carbonique dans le lait*), CL. NOURRY and C. MICHEL.—*Compt. rend., 115 (1892), No. 22, pp. 959, 960.*

Preparation of koumiss, D. H. DAVIES.—*Pharm. Jour. and Trans., 23 (1892), p. 301.*

EXPERIMENT STATION NOTES.

CALIFORNIA STATION.—A new apparatus for the accurate testing of spraying nozzles has just been constructed, and the station proposes to make a thorough study of different kinds of nozzles.

IDAHO UNIVERSITY.—The board of regents held a meeting December 31, 1892, to effect an organization.

MASSACHUSETTS COLLEGE.—At a recent meeting of the State board of agriculture it was reported that 879 students had been in attendance at the college since its foundation in 1867. Of these, 361 have been graduated. Of the graduates, 254 are engaged in farming or in closely allied pursuits, 20 are teachers in agricultural institutions, 4 are agricultural editors, and 7 are in the fertilizer business.

NEBRASKA INDUSTRIAL COLLEGE.—In a brief historical sketch of this department of the University of Nebraska, recently published by the university, it is stated that the number of students enrolled during the last academic year was 107, in addition to about 125 in the preparatory courses. A considerable portion of the funds received under the act of Congress of 1890 has been devoted to the establishment and equipment of a course in electrical engineering.

UTAH STATION.—A hydraulic engineer has been employed for the coming season to examine the irrigation systems of the Territory and to aid farmers in the introduction of irrigation. A dairyman will also be employed, with a view to the investigation of dairy questions.

WEST VIRGINIA STATION.—The botanical department of the station has been abolished and a horticultural department organized in its stead. F. W. Rane, M. S., has been appointed horticulturist and microscopist. The parasitic insect recently brought from Europe by the entomologist of the station to destroy the Scolytid which is ruining spruce forests in the State, seems likely to prove effective, provided it will multiply sufficiently fast.

WISCONSIN COLLEGE.—One hundred students were registered for the dairy school considerably in advance of the opening of the school, and many applicants were turned away. More than 50 were registered for the short course in agriculture, which began January 4 and is to close March 22.

WYOMING COLLEGE.—At the general election in November it was voted to establish the agricultural college at Lander, Fremont County, but until buildings are provided the college will remain a department of the State University.

MILK INSPECTION IN CHICAGO.—November 21, 1892, an ordinance was passed by the city council establishing a milk division of the department of health, to be in charge of a deputy commissioner of health, who must be a practical chemist. Nine milk inspectors are to be appointed. All venders of milk or cream must take out a license. Penalties are provided for violation of the ordinance either by selling without a license or failing to comply with the regulations of the health department regarding the purity of milk and cream.

GERMAN STATIONS.—The fifth convention of the Association of Agricultural Experiment Stations in the German Empire, which was to have been held in Nuremberg last September, but was postponed on account of the cholera, was held in Ber-

lin December 11, 12, and 13, 1892. The discussion of methods of analysis formed a prominent part of the program. The experiment stations of this country were represented by Prof. W. O. Atwater, of this Office, and Prof. E. W. Hilgard, of California.

GREAT BRITAIN.—The following summary of the yield and acreage of wheat, barley, and oats in Great Britain for 1891 and 1892 was recently issued by the board of agriculture.

The yield and acreage of wheat, barley, and oats in Great Britain for 1891 and 1892.

	Estimated total produce.		Acreage.		Estimated average, yield per acre.	
	1892.	1891.	1892.	1891.	1892.	1891.
WHEAT.	*Bushels.*	*Bushels.*	*Acres.*	*Acres.*	*Bushels.*	*Bushels.*
En land	55,107,186	68,694,456	2,102,969	2,192,393	26.20	31.33
Wales	1,318,763	1,461,740	55,278	61,590	23.86	23.73
Scotland	2,134,983	1,971,067	61,592	53,294	34.66	36.98
Great Britain	58,560,932	72,127,263	2,219,839	2,307,277	26.38	31.26
BARLEY.						
England	59,527,968	60,900,824	1,709,587	1,772,432	34.82	34.36
Wales	3,350,862	3,438,620	114 520	117,101	29.26	29 36
Scotland	7,622,732	7,789,651	212,703	223,265	35.84	34.89
Great Britain	70,501.562	72,129,095	2,036,810	2,112,798	34 61	34.14
OATS.						
England	73,266,495	69,786,175	1,765,463	1,672,835	41.50	41.72
Wales	7,976,830	7,698,529	233,399	234,055	34.18	32 89
Scotland	35,051,664	34,901,557	998,683	992,239	35 10	35.17
Great Britain	116,294,989	112,386,261	2,997,545	2,899,129	38.80	38.77

INDIA.—The Annual Report of the Khandesh Experimental Farm for the year ending March 31, 1892, contains accounts of field experiments with cotton, wheat, sugar cane, and forage plants, and of experiments with silage and in the breeding of cattle, sheep, goats, and horses.

AMERICAN FORESTRY ASSOCIATION.—This Association held its eleventh annual meeting at the Department of Agriculture December 20, 1892. Assistant Secretary Willits, one of the vice presidents of the Association, presided. As this was for the most part a business meeting, the attendance was confined to members of the Association.

The reports of the officers and committees showed a favorable condition of the affairs of the Association. During the past year the Association has been chiefly engaged in promoting the reservation of public timber lands from sale and in the endeavor to secure the enactment of adequate laws for the protection of the public forests from fire and theft and their administration so as to yield the largest amount of commercial products consistent with the maintenance of their appropriate climatic influence and their conservative effect upon the water supply and irrigation.

Seven reservations of forest lands have already been made by the President, viz, those of White River, Pike's Peak, and Plum Creek, Colorado; Pecos and Canadian Rivers, New Mexico; Bull River, Oregon; Yellowstone, lying south and east of Yellowstone Park, Wyoming; and San Gabriel, California. These comprise an area of more than 3,250,000 acres.

Twenty-three other proposed reservations are now under consideration by the Department of the Interior. These are situated in the States of California, Colorado, Idaho, Minnesota, Montana, New Mexico, North Dakota, Oregon, Washington, and Wyoming.

The principal discussion during the meeting was in reference to the Paddock bill, now on the calendar of the Senate. This bill, which proposes to place the management and disposal of the public timber lands under the control of the Secretary of Agriculture, is, in the main, an embodiment of the views of the Association in respect to the timber lands.

The Association seeks to have only such land as is unfit for agricultural purposes reserved from sale, and in the Paddock bill provision is made for the restoration to sale and occupancy of any portions of land included in the reservations which may be found desirable for the uses of agriculture. There is also provision for the cutting of timber at the proper time and in proper manner for the purpose of supplying the needs of domestic life and of the mining and lumber industries.

In the election of officers for the ensuing year J. S. Morton, of Nebraska, was chosen president; J. D. W. French, of Boston, was chosen corresponding secretary in place of E. A. Bowers, resigned; and N. H. Egleston was reëlected recording secretary.

It was voted to hold a meeting of the Association at Chicago during the World's Columbian Exposition and the executive committee were directed to make arrangements for it.

Movements of the leaves of plants.—Preliminary observations on the movements of the leaves of *Melilotus alba* and other plants by W. P. Wilson and J. M. Greenman, are reported in *Contributions from the Botanical Laboratory of the University of Pennsylvania*, vol. I, No. 1, pp. 66-72. The following conclusions have been drawn from the observations thus far made:

"(1) There are great numbers of plants which put their leaves in a special or *hot-sun* position.

"(2) These *hot-sun* positions have come to exist in order to protect the plants possessing them from a too rapid transpiration.

"(3) These *hot-sun* positions are not dependent on light alone, but the heat rays play a very important part in determining them; and the water supply of the plant, in the air as well as in the soil, exercises a direct influence.

"(4) For some reason not yet well understood, the leaves of *Melilotus alba* take a different position at night under red light from the one ordinarily assumed in the so-called sleep of this plant."

Chlorine in rain water.—The following data were obtained from observations at the Royal Agricultural College, Cirencester, England, as reported in the *Agricultural Students' Gazette* for December, 1892: The rainfall for the six months ending March 31, 1892, was 17.38 inches, containing on an average chlorine equivalent to 0.404 grain of sodium chloride per gallon, or 22.69 pounds of salt per acre. For the six months ending September 30, 1892, the rainfall was 13.73 inches, and the sodium chloride 0.242 grain per gallon, or 10.74 pounds per acre. The total rainfall for the year, 31.11 inches, would thus deposit about 33½ pounds of salt per acre.

Milk preservation.—A valuable pamphlet of seventy-two pages on this subject has recently been issued. It is entitled *Die Methoden der Milchkonservierung speciell das Pasteurisieren und Sterilisieren*, and is prepared by Dr. H. Weigmann, of the dairy department of the experiment station at Kiel, Germany. The subjects of milk fermentations, infection of milk, preservation of milk from fermentative changes by chemical means, by cold, by pasteurization, and by sterilization, and shipping of milk are treated in a popular style. Price, 1.50 marks.

Dairy industry of Denmark.—Prof. C. C. Georgeson, of the Kansas College and Station, has been sent to Denmark as special agent of this Department to investigate the dairy industries in that country, and to make a report covering dairy farming, manufacture of dairy products, trade conditions and methods, and educational features. Prof. Georgeson is a native of Denmark, and will, therefore, be able to come into direct communication with those from whom it will be most desirable to gather information.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

DECEMBER, 1892.

BUREAU OF ANIMAL INDUSTRY:

Special Report on Diseases of Cattle and on Cattle-Feeding.

Special Report on the History and Present Condition of the Sheep Industry of the United States.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. IV, No. 3, October, 1892.

Experiment Station Record, vol. III, Index.

Experiment Station Bulletin No. 11.—A Compilation of Analyses of American Feeding Stuffs.

WEATHER BUREAU:

Bulletin No. 5.—Observations and Experiments on the Fluctuation in the Level and Rate of Movement of Ground Water on the Wisconsin Station Farm and at Whitewater, Wisconsin.

Bulletin No. 6.—The Diurnal Variation of Barometric Pressure.

Monthly Weather Review, October, 1892.

DIVISION OF BOTANY:

Contributions from the U. S. National Herbarium, vol. I, No. 6, December 6, 1892.

DIVISION OF CHEMISTRY:

Bulletin No. 35.—Proceedings of the Ninth Annual Convention of the Association of Official Agricultural Chemists.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

DECEMBER, 1892.

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama:

Bulletin No. 39, November, 1892.—Wheat.

Arkansas Agricultural Experiment Station:

Bulletin No. 20, November, 1892.—Animal Parasitism; Some Texas Fever Experiments.

Agricultural Experiment Station of the University of California:

Report of the Viticultural Work during the Seasons 1887–'89, part I.

Maine State College Agricultural Experiment Station:

Annual Report, 1892, part I.

Massachusetts State Agricultural Experiment Station:

Bulletin No. 45, November, 1892.—On Fodder Articles and Fodder Supplies.

Hatch Experiment Station of the Massachusetts Agricultural College:

Meteorological Bulletin No. 47, November, 1892.

Agricultural Experiment Station of Nebraska:

Bulletin No. 25, December 1, 1892.—Detasseling Corn.

Cornell University Agricultural Experiment Station:

Bulletin No. 45, October, 1892.—Tomatoes.

Bulletin No. 46, November, 1892.—Mulberries.

Tennessee Agricultural Experiment Station:

Bulletin vol. V, No. 4, November, 1892.—Experiments with Fruits and Vegetables.

Agricultural Experiment Station of Utah:

Bulletin No. 19, October, 1892.—Feeding Silage *vs.* Dry Food.

West Virginia Agricultural Experiment Station:

Bulletin No. 24, June, 1892.—Flora of West Virginia.

DOMINION OF CANADA.

Department of Agriculture:

Bulletin No. 16, November, 1892.—Experiments in the Feeding of Steers.

Second Annual Report of the Experiment Station at St. Hyacinth, Quebec, 1891.

EXPERIMENT STATION RECORD

Vol. IV. FEBRUARY, 1893. No. 7.

The need of compilations of analyses of feeding stuffs and results of experiments upon their digestibility has been pressingly felt, not only by our experiment station workers, but by teachers, writers, and, indeed, all who are interested in the science of animal nutrition. A welcome effort toward meeting this need has been made by Messrs. Jenkins and Winton in the compilation of analyses of American feeding stuffs, published as Bulletin No. 11 of this Office (see p. 582), which it is believed covers the ground with reasonable thoroughness.

It is only in recent years that such investigations have become common in the United States, and although the data regarding the composition of our feeding stuffs have already become somewhat voluminous they are far from complete, and our investigations upon the constitution of the compounds contained in them and their digestibility are comparatively limited. In Europe, however, a large amount of investigation regarding the digestibility as well as the chemical composition of such materials has accumulated, but the results of inquiry in these as in other specialties are widely scattered and have not hitherto been readily available to us. A compilation in which they should be completely, clearly, and concisely set forth and thus made easily accessible to us was greatly to be desired. Such a treatise has been prepared by Professors Dietrich and König and lately published.* It is designated as the second edition of a work with similar title by the same authors published in 1874, but it is so much enlarged and improved that this designation is hardly more than a tribute of appropriate respect to the earlier and far less extensive treatise.

The purpose of the authors has been to put together in the most convenient, complete, and useful form the accumulated information

* Zusammensetzung und Verdaulichkeit der Futtermittel, von Dr. Th. Dietrich und Dr. J. König. Zweite vollständig umgearbeitete und sehr vermehrte Auflage. Berlin, Julius Springer.

regarding these subjects. To quote the words of Prof. Hellriegel in a review of the work:* "The amount of pains taken to insure the prime condition of usefulness, namely, the most absolute completeness possible, is shown not only by the tables, * * * but more especially by the fact that all of the available work in agricultural chemistry, back to the earliest times in which serviceable analyses were to be looked for, has been collected, and that even unprinted material, in so far as it could be obtained by correspondence, has been incorporated, and with the most valuable results. The order and arrangement of this mass of material are most excellent. We have not only a careful grouping of figures, but the results of independent work conceived in a philosophical spirit and carried out with scholarly skill."

A more detailed account of the nature and contents of the work is given on page 595 of the present number of the Record.

Such a treatise is not for the many, but for the few. Its place is in the reference library and on the desk of the investigator, teacher, and writer. There it will be of permanent value. Although the science of nutrition is rapidly advancing and new data are constantly being obtained, such a work as this must long be the standard. Future compilations may begin where this leaves off. When the methods of analysis, of estimating nutritive values, and of conducting experimental inquiry shall have been sufficiently improved, other ways of expressing the composition, digestibility, and nutritive values of feeding stuffs will be called for, and other forms of compilation will be developed.

The two savants to whom we owe this service, while studying physiological chemistry by researches in the laboratory and observations outside, have devoted well-nigh a dozen years to gathering the data for the compilation and putting them in order. The work of preparing and issuing this compendium has been very largely a labor of love, for neither authors nor publishers expect any pecuniary gain from it. In fact the German Government has undertaken to provide for a portion of the expense involved in its publication.

To make use of this treatise the slightest knowledge of German will suffice, since the titles of the tables and the principal statements of the text are expressed in the simplest and briefest terms.

The preliminary report of Prof. Georgeson, recently sent to Denmark as special agent of this Department to study the dairy industry of that country, brings out the very interesting and important fact that the uniformly good quality of Danish butter is principally due to the use of pure cultures of bacteria for ripening the cream, which have so far obtained the approval of practical dairymen in that country that they are commonly employed "in all good dairies."

*Landw. Vers. Stat., 40, p. 262.

It is evident that any practical plan for the wide distribution and use of these butter ferments will revolutionize the dairy industry, and there seems to be no good reason why bacteria should not be used in butter-making as generally as yeasts now are in bread-making and brewing. The rapidity with which this newly discovered scientific truth has been applied to practical uses may be seen from the fact that it was only in 1890 that the researches of Storch and Weigmann were published which showed that bacteria might be employed to give the desired flavor to butter (see Experiment Station Bulletin No. 9, p. 67).

Such an event as the introduction of bacteria cultures into practical dairying should greatly encourage the investigator in agricultural science to persevere in truly scientific inquiries, and should help the farmer to see more clearly that agriculture will reap the highest benefits from researches pursued by thoroughly trained experts working according to scientific methods.

The facts regarding the production and value of crops in this country brought out in the report of the Statistician of this Department (an abstract of which is given on p. 578), as well as in other similar reports, are well worth the careful study of investigators in agricultural science, and especially of those who are planning experiments with field crops, vegetables, or fruits. Amid the multiplicity of questions which are urged upon the attention of the experimenter it is increasingly difficult to make a wise selection of the few which ought to engage the serious attention of any one station. There is a danger that in yielding to a local demand for the testing of new crops or the improvement of old ones the real interests of even that locality may be sacrificed. If there is little prospect that even under improved conditions of agriculture it will pay to increase or keep up the acreage of a crop it is doubtful whether a station should by means of important experiments increase the interest of the farmers of its region in that crop. It would be better to divert their attention to something which will be likely to bring them more profit.

It may be very easy, on the other hand, for a station to demonstrate that a region is well adapted for a crop not hitherto grown there, but of what use will this be to the farmers of that region if it is a crop for which they are not likely to find a profitable market? As it becomes increasingly clear that the agricultural prosperity of any region or country depends very largely on conditions which are world-wide in their influence, not only the farmer but also the experimenter should as far as practicable shape his work with reference to these conditions. It is true that the more particular study of these wide problems would naturally devolve upon the officers charged with making the general plans for the station's work, but even the specialist can well afford to take time for consideration of such questions that he may be better able to guide his work into those lines which promise the most useful results.

THE RELATION OF THE PHYSICAL PROPERTIES OF THE SOIL TO THE CULTIVATION OF PLANTS.

DR. EWALD WOLLNY.

The efforts toward the discovery of the laws that underlie the right cultivation of crops have, up to the present, been devoted mainly to the nutrition of the plant, and the research has been for the most part in the domain of chemistry. Extended and careful inquiry has revealed most important relations between the chemical composition of the soil and the quantity and quality of vegetable product which it is capable of producing. The investigations of such men as Davy, Sprengel, and especially Liebig and his followers have shown what elements the plant requires for the building up of its organs; how they are distributed through the several parts of the plant; the variations in the composition of the plant at different periods of growth, and under different conditions of development; what elements the plant obtains from the air and what from the soil, and in what amounts and forms the several elements are needed for normal growth. The practical value of these contributions of chemistry to agriculture can hardly be overestimated. The vast and constantly increasing use of artificial fertilizers alone, bears sufficiently impressive witness to their importance.

It is not strange that when these chemical factors of vegetable production have been found so weighty the other factors should have failed to meet full appreciation and that investigators, following the beaten paths of inquiry, should have neglected other lines which would lead to knowledge no less essential to the practice of agriculture.

Witness, for instance, the fact that the supply of plant food by the most careful manuring does not always bring the crops which we have the right to expect. The poor results of the use of artificial fertilizers on light soils in dry climates, on heavy soils in moist climates, or with very heavy stand of plant growth, are illustrations of this. So likewise we find that the development of a given species of plant, with a definite demand for plant food, varies greatly with differences in the physical condition of the soil, with climate, weather, temperature, moisture, and other factors. In short the growth of the plant is determined, not merely by the food at its disposal, but by the other conditions which govern its physiological processes. These other conditions are in part meteorological, but they are especially related to the physical characters of the soil.

The physical characters of the soil which are most important in their influence, have to do with (1) the mutual relations of the soil particles and (2) the relation of the whole mass of the soil to air, water, and heat.

Upon the character and arrangement of the particles depend the porosity of the soil, the readiness with which air penetrates it, its water-holding capacity, the readiness with which water moves through it, and finally its temperature. The direct and indirect influence of these factors upon vegetable production and the general laws by which they are regulated form the subject of the present article.

The physical properties of the soil in general and the ways they affect the growth of plants may be discussed under four heads.

A. The properties themselves in their direct influence upon vegetation.

B. The relation of the physical to the chemical properties of the soil. Among the chemical processes are included fermentative changes, such as ammonification, nitrification, denitrification, and the like. The discussion of this topic, therefore, involves the consideration of the influence of the physical characters of the soil upon the operations by which plant food is rendered available or unavailable, and the consequent indirect influence of the physical characters upon plant growth.

C. The relations of the physical properties of the soil to each other and their resulting indirect influence upon plant growth.

D. The soil factors of plant growth which are altered by physical agencies and their relation to other factors of plant growth.

A. THE PHYSICAL PROPERTIES OF THE SOIL IN GENERAL AND THEIR DIRECT INFLUENCE UPON VEGETABLE PRODUCTION.

We have to consider here: (1) The cohesion of the soil particles, *i. e.*, the coherence (compactness) of the soil, (2) the permeability of the soil to air, (3) the moisture of the soil, and (4) the temperature (heat) of the soil.

(1) *Cohesion of the soil.*—The force by which the particles are held together decides the compactness or tenacity of the soil. This factor is most important in deciding the ease of tillage and the readiness with which the roots of plants can penetrate in their search for food and water. It is of importance in the subsoil as well as in the surface soil. Its proper regulation by tillage and manuring is one of the essentials of successful culture.

(2) *Permeability of the soil to air.*—The necessity of oxygen for the roots of the plant makes this an essential factor of soil fertility. Some soils are so open that air diffuses through them readily and to considerable depth; others are so close that it works its way with difficulty at best, and when the interstices are filled with water it can hardly penetrate and diffuse at all.

(3) *The moisture of the soil.*—It is scarcely too much to say that, of all the materials the plant derives from the soil, water is the most important, and for the reason that it is not only the largest constituent of the plant tissue, but is also the purveyor of the other materials, so that the vegetative functions are entirely dependent upon it. Hence the development of the plant varies with the water supply. For each species there is a certain water content in the soil which is most favorable for growth. This is illustrated by the following results of experiments by the author:*

Effects of different proportions of water in the soil upon the growth of summer rape.

Water in soil in per cent of total water-holding capacity.	Produce (six plants in each case).				
	Number of pods.	Weight of plants (air dry).			
		Seed.	Straw.	Chaff.	Total.
		Grams.	*Grams.*	*Grams.*	*Grams.*
10	43	1.4	2.8	1.4	5.6
20	61	2.4	4.4	2.6	9.7
40	142	6.9	10.4	6.7	24.0
60	97	4.3	8.1	4.4	16.8
80	95	3.9	7.3	3.9	15.1
100	19	0.3	2.0	0.6	2.9

The maximum product was realized when the water in the soil was equal to 40 per cent of the amount it was capable of holding. With less water there was less produce. Increasing the water likewise diminished the yield until, when the soil was saturated, the growth was almost entirely checked. Similar results were obtained by the author with summer rye.

Since the growth of the plant as a whole is so dependent upon the proportion of water in the soil, it is not strange that the development of the individual organs should be affected in like manner, as is illustrated in a series of experiments by Haberlandt,† in which summer wheat was grown in soil in pots with varying quantities of water.

Effects of different proportions of water in the soil upon the development of the organs of the wheat plant.

Water added per pot .... c. c..	24,800	14,400	6,200
Weight of roots............grams..	5.4	3.2	2.9
Number of stems..................	30	25	21
Length of shortest stem.......cm..	70	30	20
Length of longest stem........cm..	95	65	35
Number of kernels	510	118	3
Weight of 1,000 kernels....grams..	41.6	29.4	21.8

* Forsch. Geb. agr. Physik, 10 (1887), p. 154.

† Oesterr. landw. Wochenbl., 1875, No. 30, p. 352.

The effect of water is likewise manifested in the development of the assimilative organs. This is shown by carefully conducted experiments of Sorauer,* from the results of which the following average figures are taken:

Effects of different proportions of water in the soil upon the leaf development of barley.

Water in soil.	Leaves.		Number of stomata.
	Average length.	Average width.	
Per cent.[1]	*Mm.*	*Mm.*	*Per plant.*
60	182 2	9.4	226,402
40	166.3	9.1	
20	138.7	6.8	179,712
10	93.7	5.6	138,203

[1] Per cent of total water-holding capacity of soil.

In general the development of the plant improves with increase of water in the soil up to a certain proportion of the water-holding capacity of the soil. When this optimum proportion of water is exceeded the development is retarded. The optimum water content of the soil varies with the plant and the soil.

The influence of the proportion of water in the soil is manifested still further in the length of the period of growth, which is generally shorter as there is less, and longer as there is more water in the soil.

Finally the chemical composition of the plant appears to be influenced more or less by the amount of water at its disposal in the soil. At least analyses of cereal grains grown under different conditions imply that dry soil favors the development of a glassy grain with relatively large nitrogen content, while with more moisture the texture of the grain is looser, it is more mealy, and the proportion of nitrogen is smaller.†

The explanation of this very important role of soil water in the economy of plant growth is twofold. Water is essential to the structure and nutrition of the plant, and large quantities are used in transpiration:

The cells of the growing organs of the plant consist largely of water. Water serves as the purveyor of food from the soil to the plant. It is also the agent for dissolving elaborated material in the plant and transporting that material to the organs in which it is more or less permanently stored. For thus building up the tissues and carrying food and plant substance large amounts of water are needed.

But the largest demand for water in the plant is occasioned by the transpiration of vapor through the aërial organs, especially the leaves. The magnitude of this evaporation of water from the plant is illustrated

* Bot. Ztg., 1873, p. 10.

† Wollny: Die Kultur der Getreidearten, 1887, p. 75.

by the following observations of Hellriegel* and of Wollny,† who measured the quantities of water used by different plants during their period of growth. The quantities are given in kilograms of water used for each kilogram of dry matter harvested in the plant.

Proportions of water transpired through the plant during the period of growth.

Experiments by Hellriegel.		Experiments by Wollny.	
Kind of plant.	Water consumed for each kilogram of dry substance in the plant.	Kind of plant.	Water consumed for each kilogram of dry substance in the plant.
	Kilos.		*Kilos.*
Horse beans	262	Maize	233
Peas	292	Millet	416
Barley	310	Peas	447
Clover	330	Sunflower	490
Spring wheat	359	Buckwheat	646
Buckwheat	371	Oats	665
Lupine	373	Barley	774
Spring rye	377	Mustard	843
Oats	402	Rape	912

The quantity of water transpired by the plant is thus seen to be very large. In the experiments here cited it ranged from 233 to 912 times the weight of dry substance in the crop. Although these experiments on a small scale in pots do not give an accurate idea of the quantities actually transpired by plants in ordinary field culture, they do show that those quantities must be enormous.

The explanation of the transpiration of water is comparatively simple. The interior of the plant is connected with the ambient air by the stomata which occur in the aërial organs, chiefly in the leaves. Through these the water passes from the cells near the surface into the air. These cells take water by imbibition or osmose from the interior cells. A constant current of water is thus flowing through the plant and out of it by the foliage. The latest and best investigation indicates that no considerable proportion of this water enters through the foliage.‡ It must therefore come through the roots and from the soil.

The quantity of water transpired varies with the leaf surface of the plant and with the length of the period of growth. With a given plant it is small in the earlier periods of development, increases with leaf

* Beiträge zu den naturwissenschaftlichen Grundlagen des Ackerbaues, pp. 622–664.

†Der Einfluss der Pflanzendecke und der Beschattung auf die physikalischen Eigenschaften und die Fruchtbarkeit des Bodens, pp. 123–125.

‡Sachs: Vorlesungen über Pflanzenphysiologie, 1882, p. 305, and Burgerstein: Uebersicht der Untersuchungen über die Wasseraufnahme der Pflanzen durch die Blätter, Jahresbericht des Leopoldstädter Real- u. Obergymnasiums in Wien, 1891.

development to a maximum, decreases again as the plant ripens and its vegetative functions becomes less active, and finally stops. It is larger as the stand of plants is heavier. It is larger with plants which keep up their physiological activity during the whole period from spring until late autumn than with those whose time of active growth is short.

Among the common cultivated plants, the perennial fodder plants, such as clovers and grasses, consume the most water for a given area of land, because of their large leaf surface, close stand, and long period of growth. Then come the legumes which have a shorter period of growth, such as field beans, and soja beans; the oil plants, like rape and sunflower; the legumes with still shorter growth, as peas and vetches, and then the cereals, which are grown for seed. Among the latter, wheat and oats require the largest amounts of water because of their larger foliage and their relatively long period of growth; next to these in demand for water ranks barley, and lastly rye. In general, the winter grains consume less water than those sown in spring, because their period of growth covers a shorter part of the season when the water consumption is greatest. The plants which are cultivated at some distance apart, such as potatoes and roots, consume the least water of all. In general, the most favorable quantity of soil water for the growth of plants is from 40 to 75 per cent of the total quantity which the soil is capable of holding. With too much water, as well as with too little, the crop is reduced.

Why excess of soil water prevents the normal development of the plant is not yet fully understood. The old explanation that the temperature of the soil is thereby materially lowered is not sustained by the facts of later observation.' The more probable explanations are two. The first is that excess of water in the soil prevents the diffusion of air, including oxygen, which must be at the disposal of the roots to insure healthy growth. The second is that with too much water and too little oxygen the chemical changes which are brought about by ferments and otherwise, and which facilitate the development of the plant, are hindered, while others unfavorable to the plant are induced.

Among the fermentative changes in the soil which favor plant growth are to be counted especially those due to the aërobic organisms (which are sometimes designated by the Latin word *fermentatio* and by the German *Verwesung*), such as ammonification and nitrification. It is by these means that the nitrogen of the soil is made available for plant food. Oxygen is needed for these fermentations. In a soil surcharged with water oxygen does not obtain ready access and the fermentative changes can not proceed normally. Furthermore, in lack of oxygen injurious compounds, *e. g.*, ferrous salts, are formed in the soil, and anaërobic fermentations take place which result in loss of nitrogen, either in the form of oxides or in the free state.

(4) *The temperature of the soil.*—The growth of the plant is as dependent upon the temperature of the soil as it is upon that of the air.

This is clear when we consider that during germination and in the first period of development the whole plant, and later its most important food-gathering organs, namely, its roots, are dependent upon the soil for their heat.

The effect of temperature upon the development of the plant follows a definite law. In accordance with this law there is for each plant a minimum temperature, more or less above the freezing point, at which development is feasible, an optimum which is most favorable, and a maximum, generally between 40° and 50° C. beyond which it is impossible. This applies to the germination as well as to the later growth. It is a fact especially worthy of note that the optimum temperature is seldom exceeded in our climate, so that we have practically to do with the range between this and the minimum.

The temperature of the soil has an especially marked influence in the germination of the seed and in the starting of the spring growth of plants which have passed the winter in the ground. Thus rye, vetch, and peas begin to germinate at a soil temperature of about 1° to 2° C.; wheat, barley, and oats, at 4° to 4.5°; maize and sunflower, at 8° to 10°; and tobacco, at 13°. In like manner the majority of our perennial cultivated plants do not begin their growth in spring until the soil has attained a temperature of 4° to 5° C.*

The warmer the soil the more quickly does the seed germinate. This is illustrated by the accompanying results of experiments by Haberlandt,† in which observations were made of the number of days required for the germination of seeds of a number of species of plants at different temperatures. The first appearance of radicles was taken as indicating the time of germination.

Days required for germination of seeds, with different temperatures of the soil

Kind of plant.	4.38° C.	10.25° C.	15.75° C.	19.0° C.
	Days.	*Days.*	*Days.*	*Days.*
Red clover	7½	3	1¾	1
Pea	5	3	1¾	1¾
Horse bean	7	6½	4¾	4¼
Tobacco	....	....	9	6¼
Hemp	8	4½	2	2
Poppy	10	4¾	2½	2
Rape	6	2	1	1
Sugar beet	22	9	3¾	3¾
Maize	....	11¼	3¼	3
Spring barley	6	3	2	1¾
Spring rye	4½	2	1½	1
Spring wheat	6	4	2	1¾

Not only is germination quicker, but the development of the organs of the plant proceeds more rapidly with higher soil temperatures. This

* Compare Haberlandt: Landw. Vers. Stat., 17 (1874), p.104, and Wissenschaftlich-practische Untersuchungen a. d. Geb. des Pflanzenbaues, Bd. I.

† Der allgemeine landw. Pflanzenbau, Vienna, 1879, p. 40.

latter fact is brought out by experiments of Sachs, in which the growth of roots and aërial parts of maize in forty-eight hours (length in centimeters) was as indicated in the following table: *

Growth of roots and tops of maize plants in forty-eight hours at different temperatures.

	Temperature of soil.			
	17.1° C.	26.2° C.	33.2° C.	34.0° C.
	cm.	*cm.*	*cm.*	*cm.*
Roots	2.5	24.5	39.0	55.0
Aërial organs	4.6	5.6	11.0	13.0

In like manner the whole productive power of the plant increases with rise of soil temperature until the optimum degree is reached. Above this the production diminishes. This is illustrated by observations of Bialoblocki on the growth of cereals in pots the soil of which was maintained at temperatures varying with the different pots, but constant for each pot during the period of growth.† The figures herewith represent the average weight per plant when harvested while still small.

Effects of different soil temperatures upon development of cereal plants.

Temperature of soil.	Average weight of dry substance per plant.		
	Rye.	Barley.	Wheat.
Degrees C.	*Milligrams.*	*Milligrams.*	*Milligrams.*
10	22.8	18.0	20.8
15	32.4	34.4	29.5
20	49.5	36.7	30.8
25	42.4	42.0	43.9
30	47.0	35.0	46.9

The plants were harvested in the early period of growth, but the same influence of temperature continues until maturity, as is illustrated in experiments‡ by the same investigator, in which barley grew until ripe under conditions similar to the preceding. The results were as follows:

Effects of different soil temperatures upon yield of barley.

Temperature of soil.	Weight of plants per pot at maturity.			
	Grain.	Straw.	Chaff.	Total.
Degrees C.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
10	2.71	3.36	0.52	6.59
20	3.18	4 50	0.63	8.31
30	2.37	2.04	0.36	4.77
40	1.46	1.53	0.24	3.23

* Handbuch der Pflanzenphysiologie, 1865, p. 72.
† Landw. Vers. Stat., 13, p. 424.
‡ Ibid.

There is a direct relation between soil temperature and the imbibition of soil water by the plant. In general the quantity of water the plant takes up through its roots appears to increase with rise in temperature up to a certain optimum. This means better provision of the aërial organs not only with water, but also with the soil ingredients of its food which the water brings to the plant. On the other hand, when the temperature of the soil sinks the water supply to the plant diminishes and may become so small as not to meet the demand for transpiration. Thus, at a temperature of 5° C., certain plants, *e. g.*, tobacco, maize, and squash, may be unable to draw enough water from the soil through their roots to make up for the loss through their leaves, and in consequence they wilt.

Finally, it is to be observed that the temperature of the soil influences that of the air in contact with it.

The influence of soil temperature will be still further considered in the succeeding chapter.

B. THE RELATION OF THE PHYSICAL TO THE CHEMICAL PROPERTIES OF THE SOIL—FERMENTATIONS.

On closer consideration of the chemical properties of the soil it becomes evident that they are controlled in no small degree by its physical characteristics. This is especially the case with the processes of decomposition of organic substances, the weathering of the mineral constituents, and also the behavior of the nitrates which are formed in the soil. This fact is of great practical importance to the farmer, since it teaches that by suitable treatment he can directly influence not only the processes themselves, but also the quality of the valuable plant food which is elaborated by them. To accomplish this in rational ways, however, it is essential to understand these processes thoroughly. Hence an explanation of their essential points and their relation to the physical properties of the soil will not be out of place here.

The organic substances with which we are chiefly concerned here are those contained in the animal and vegetable residues of fertilizers such as stable manure and compost, in the green plants used in green manuring, and in stubble and humus. The chemical changes* which these undergo are determined by the presence or absence of oxygen. In the one case oxidation, and in the other deoxidation takes place.

When the atmospheric air has free access the decomposition products of the organic compounds are carbonic acid, water, and ammonia; and the mineral constituents, which are to a certain extent inclosed in the organic matter, and not in a condition to be assimilated, are set free and pass into forms in which the plant can use them. This decomposition acts directly in furnishing valuable nutritive material,

* Wollny: Journ. Landw., 34 (1886), pp. 213-230.

as ammonia and mineral matters, for the plant. It also exerts a beneficial influence on the fertility of the soil indirectly by the development of compounds like carbonic acid, which assist in the weathering of undissolved materials which are capable of being made soluble.

This process—decomposition in distinction from putrefaction, or more properly oxidation as distinguished from reduction—is characterized by leaving non-volatile residues, which are composed mainly of mineral matters, in forms capable of assimilation.

The fact that the combined oxygen of organic matter is insufficient for its oxidation indicates that the oxygen of the atmosphere takes part in this process, and the experiments by Boussingault and Levy* support the same view. These latter experiments showed that the soil air is poorer in oxygen in proportion as it is richer in carbonic acid, and that the sum of the volumes of the oxygen and of the carbonic acid is approximately a constant quantity. The details of these experiments follow:

Proportions of air and carbonic acid in soils under different conditions of culture.

Kind of soil.	Culture.	Contained in air of soil in per cent by volume.		
		Carbonic acid.	Oxygen.	Sum.
Sand, manured		9.74	10.35	20.09
Sand	Vineyard	1.06	19.72	20.78
Sand, very stony	Forest	0.87	19.61	20.48
Sand, unmanured	Asparagus	1.54	18.80	20.34
Pits, with rotten wood		3.64	16.45	20.09
Chalky	Red beets	0.87	19.71	20.58
Heavy clay	Artichokes	0.66	19.99	20.65
Fertile, moist	Meadow	1.79	19.41	21.20

It is evident from this that the oxygen of the soil air decreases as the carbonic acid increases. These and other facts lead to the conclusion that the oxygen of the air takes a very prominent part in the oxidation of the carbon of organic substances.

Aërobic ferments in the soil.—Oxidation.—The nitrogenous materials with which we have to do here are principally the protein compounds. These undergo a change which results principally in the formation of ammonia. If the entrance of air is unhindered the ammonia is in all cases oxidized to nitric acid. The process of nitrification goes on very rapidly when the soil is well aërated. This is shown both by the fact that when air has free access ammonia occurs only in small quantities in tilled soils; and by the observations of various experimenters which indicate that a rapid change of ammonia to nitric acid goes on in fertilized soils. For example, W. Wolf † found the following quantities of

*Ann. Chim. et Phys., 37, ser. 3, p. 5. See also Jahresber. agr. Chem., 1852, p. 783.
† Amtsbl. landw. Ver. Sachsen, 1872, p. 1.

nitrogen in the forms of nitric acid and ammonia in kilograms per hectare in a cultivated soil 20 cm. in depth:

Nitrogen in soils per hectare.

	Clay slate.	Gray wacke.	Gneiss.	Gneiss.	Green-stone.	Red sand-stone.
	Kilos.	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos,*
Nitric acid	271.50	435.20	467.8	82.1	521.6	552.6
Ammonia.........	26.19	19.15	27.3	6.3	89.4	27.9

Levy's* observations on the composition of sewage used for surface irrigation of fields near Paris, and of the drainage water from these fields, are very interesting. The quantities of nitrogen occurring in the forms of ammonia and nitric acid are given herewith:

Nitrogen as ammonia and nitric acid per liter of water.

1882.	Sewage water.		Drainage water.							
			Asmières.		Cases.		Epinay.		Moulin de cage.	
	In NH_4.	In HNO_3.	In NH_4.	In HNO_3.	In NH_4.	In HNO_3.	In NH_4.	In HNO_3.	In NH_4.	In HNO_3.
	Mg.	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
Mar	17.4	1.4	0.9	23.7	0.8	27.9	0.8	19.9	0.9	17.9
Apr	20.7	0.9	0.8	24.8	0.8	18.4	0.9	22.9	0.8	20.6
May	21.0	1.0	0.8	25.5	0.8	22.9	0.9	21.1	0.9	17.4
June ...	28.7	0.8	0.9	25.3	0.8	29.6	0.8	19.0	0.9	19.2
July....	29.1	1.1	0.9	23.9	1.1	32.5	0.8	22.6	0.8	18.3
Aug....	32.6	0.4	0.8	23.3	0.9	31.3	0.8	23.2	0.8	19.9
Sept....	21.1	....	0.8	....	0.8	....	0.8	26.6	0.9	20.1
Oct.....	....	....	0.9	....	0.9	....	0.9	....	0.9	....
Average	24.4	0.9	0.9	24.4	0.9	27.1	0.8	22.2	0.9	19.1

These figures clearly show that the nitrogen, which was added in the form of ammonia, was almost entirely oxidized to nitric acid, inasmuch as the sewage when added contained only ammonia with traces of nitric acid, while the drainage water, after its passage through the soil, contained nitric acid almost exclusively.

Leaving out of account the still unsettled question as to the passage of nitrogen into the free state during the process of decomposition when air has full access, the process in question becomes a very simple one, namely, the formation of (1) carbonic acid, (2) ammonia which is changed to nitric acid, and (3) water from the decomposing plant and animal substances, and the leaving behind of a non-volatile residue of mineral matter. Naturally this change does not occur at once, but it proceeds more or less slowly as external conditions may determine. This process brings about continuous changes in the chemical and physical character of the decomposing organic substances, and thus

*Annuaire de l'observ. de Montsouris, 1884, p. 408.

gives rise to a dark colored, gradually volatilizing mass of varying composition which is designated as "mild humus."

It was formerly the general belief that these oxidation phenomena were purely chemical, but later researches have shown that the process is a physiological-chemical one, at least to the extent that it can not take place without the aid of microörganisms.

The first proof of this was obtained by Schlösing and Müntz*, from a study of the change of ammonia into nitric acid during decomposition. The investigation was made in the following manner: A specimen of soil in which nitrates were rapidly being formed was charged with vapor of chloroform and then saturated with sewage. If the nitrification was caused by microörganisms the activity of the latter would be suspended by this treatment with chloroform; and in fact this result followed, for the outflowing water contained ammonia in large quantity, while the amount of nitrates and nitrites was diminished. In a further trial Schlösing observed that when the soil was heated to 100° C. no more nitric acid was produced, an observation which has been confirmed by other investigators. The nitrifying microörganism was found in suitable culture solutions to which a particle of soil had been added, and which were exposed to the air. Both investigators† observed it as a long, very small, bright form. Winogradsky‡ has recently adduced proof that the change of the ammonia of decomposing organic nitrogenous material to nitric acid is caused by the coöperation of definite microörganisms, one effecting the change from ammonia to nitrous acid and a second oxidizing this to nitric acid. After many careful experiments this investigator§ succeeded in isolating both the nitrous and the nitric acid ferment from different soils. He has named the former "nitrosomonas" and the latter "nitrobacter."

The occurrence of the nitrifying ferments is very widespread, and it is seldom that a tilled soil is met with which does not contain them. As regards their distribution through the soil, the researches of R. Warrington‖ on a clay soil indicate that the organism does not occur below a depth of 45 cm. from the surface. It is, however, possible that this organism may reach a greater depth by means of worm holes and channels made by roots. Although probable, there is no proof that the organism penetrates more deeply in sandy soils. These facts are in accord with the researches of R. Koch,¶ who states that the microorganisms in soils which he investigated at different depths decreased rapidly until at the depth of 1 meter the soil was almost free from bacteria. Fülles's** observations point to the same conclusion.

* Compt. rend., 80, p. 1250; 84, p. 301; 85, p. 1018; 86, p. 892.

† Compt. rend., 89, p. 891.

‡ Ann. Inst. Pasteur, 4, Nos. 4, 5, 12; 5, Nos. 2, 9.

§ Arch. des sciences biol. publieés par l'inst. imp. de méd. expér. de St. Pétersbourg, 1892, 1, Nos. 1, 2.

‖ Journ. Chem. Soc., 1884, p. 637-650.

¶ Mittheilungen aus dem kaiserl. Gesundheitsamte, I, Berlin, 1881, 34-36.

** Zeitsch. Hygiene, 10 (1891), p. 225.

Certain conclusions are to be deduced from these facts, which, although simple, may nevertheless be very easily overlooked in practice. For example, inasmuch as the oxidation of organic nitrogenous substance takes place only in the surface soil, the nitrates of the subsoil and the drainage water must have had their origin in the surface soil and have been carried downward by washing out or diffusion.

After these investigations had furnished proof that nitrification is due to the vital activity of lower organisms, the question arose whether the oxidation is the result of similar conditions, and the following experiments by the writer* were carried out to decide this point: Several specimens of soil were either treated with various antiseptics, as mercuric chloride, thymol, carbolic acid, etc., or were heated at 115° C., and the subsequent evolution of carbonic acid noted. The result was that the formation of carbonic acid, which ordinarily proceeds with considerable vigor, was reduced to a minimum as soon as the specimen of soil was treated with small quantities of mercuric chloride or heated. From this it is to be inferred that the oxidation of carbon during the process of decay of organic substance is also a physiological-chemical process, that is to say, one dependent on the vital activity of lower organisms, as these results can be explained in no other way.

From the fact that such considerable quantities of carbonic acid result from the decomposition of organic substances when well exposed to air, and also that these microbes occur in such enormous numbers in the soil, it must be concluded that their field of activity is a very comprehensive one. Koch† found even in winter large numbers of lower organisms in the soil, not only in thickly populated places, as Berlin, but also in land distant from habitations. In like manner investigations undertaken at the observatory‡ at Montsouris, Paris, show the number of germs of bacteria to be immense. For example, in a gram of earth from the observatory lawn, 750,000, and in a like quantity from Gennevilliers from 870,000 to 900,000 germs were found. L. Adametz § placed the number of bacteria in 1 gram of soil from the experiment station field at Leipsic at 500,000 for the surface and 460,000 for the lower strata. Higher numbers were obtained by Fülles in his investigations of different soils in the neighborhood of Freiburg in Baden.

With the exception of the nitrifying ferments very little is known of the nature of these organisms, and especially of their relation to decomposition processes, as the investigations in this direction are still incomplete. According to the microscopic analyses of Koch, Adametz, and Fülles it may be definitely assumed that all three of the groups of

* Journ. Landw., 34 (1886), p. 221–239.

† *Loc. cit.*

‡ Annuaire de l' observ. de Montsouris, 1882.

§ Untersuchungen über die niederen Pilze der Ackerkrume. Inaugural-Dissertation, Leipzig, 1886.

lower organisms studied by C. Nägeli,* namely molds, yeasts, and bacteria, occur in the soil, but that the last named are most abundant. Among the bacteria the bacilli are the most plentiful in the surface soil, while the micrococci and other bacteria, as *Bacterium*, *Vibrio*, etc., are present only in small numbers. P. Miguel found in a soil at Montsouris 90 bacilli and only 10 other kinds of bacteria among 100 forms.

From a biological standpoint the microbes in question, which induce oxidation, are to be classed among the aërobic ferments,† that is to say, those which need the oxygen of the air to maintain their life.

Having thus considered the part played by the lower organisms in the chemical processes of the soil, we have now to designate more specifically the individual factors by which the action of these organisms is regulated. It may be assumed, *a priori*, from the known relations which exist between the environment of these organisms and their functions, that the occurrence of different species in the soil, their multiplication and their activity are all dependent on a series of factors. In fact the investigations cited show that the permeability to air, the moisture, and the heat of the soil, *i. e.*, its physical characteristics, exert the greatest influence upon the nature and intensity of the decompositions which go on within it.

With regard to the access of air, the researches of Schlösing‡ show that the amount of nitrification is dependent on the supply of oxygen, but even when only a limited quantity of oxygen is present, the amount of nitrates formed may still be considerable. The experiments referred to were conducted on five specimens of soil, rich in humus, each two kilograms in weight. They were placed in large glass tubes and aërated with mixtures of oxygen and nitrogen in varying proportions. Between July 5 and November 7, 1872, the following amounts of nitric acid were formed:

Proportion of oxygen in the air, per cent	1.5	6.0	11.0	16.0	21.0
Quantity of nitric acid formed, milligrams	45.7	95.7	132.5	*246.6	*162.6

* Schlösing thinks that the last two experiments may have been interchanged.

The quantity of nitric acid increased notably with the increase of the oxygen of the atmosphere, but still it was by no means inconsiderable even with a limited supply, a circumstance which may perhaps be attributed to the management of the experiment. That is to say, in order to keep the composition of the mixture of gases in the soil constant it was drawn through the tubes so that even when the proportion of oxygen was small the absolute quantity available for oxidation was not inconsiderable. That the nitrifying process may be brought to a standstill by an insufficient supply of oxygen may be seen from the

*Nägeli: Die niederen Pilze, München, 1877.
†Hueppe: Die Methoden der Bacterienforschung, Wiesbaden, 1886, 3d edition.
‡Compt. rend., 77(1873), pp. 203, 353.

fact that under these conditions the nitrates of the soil are finally reduced and, further, from experiments by Boussingault* and Millon.† These observers found that a soil which was saturated with water and on that account impermeable to air, would not support the process of nitrification. From this, as well as from the experiments of F. Soyka,‡ it may be concluded that the oxygen necessary to support the process has a certain minimum limit, that with the increase of oxygen the nitrifying process is accelerated, and that below this limit the opposite process—denitrification—will take place.

The oxidation of the carbon of organic substances is dependent on the access of air in the same manner as the nitrifying process. Although the experiments of Schlösing and of the writer§ bearing upon this point are not exactly fitted to show this relation clearly, because the air in the experiments was drawn through the soil, and thus constantly renewed, while the air in the soil under natural conditions is much less rapidly changed, nevertheless they may serve for an approximate estimate of the relation between the quantity of oxygen and the amount of decomposition of organic substances. With this restriction the following data from experiments of the writer may be cited in illustration:

With air containing:					
Oxygen ....per cent..	21	15	8	2	....
Nitrogen........................per cent..	79	85	92	98	100
The quantity of carbonic acid in 1000 cc. was .cc..	12.509	10.883	10.078	3.619	3.336

In general the amount of carbonic acid increased with the quantity of oxygen supplied, but did not cease entirely even when the soil was completely saturated with an indifferent gas, as nitrogen. In this case evidently the carbonic acid can only be formed at the expense of the oxygen of easily reducible substances. Among these latter may be mentioned nitric acid, and iron and manganese in the higher stages of oxidation, which with diminished access of air are reduced and pass into the lower stages of oxidation.

The water content of the soil is of especial significance for the activity of the organisms in question. A medium degree of moisture seems to be best adapted to the development of the nitrifying ferment, inasmuch as a higher or lower water content hinders the oxidation of the nitrogenous organic matter. A soil in which nitrification is going on rapidly may be rendered entirely sterile by drying. In general the decomposition of organic matter increases with the water content of the soil up to a certain limit, as may be seen from the increase in the amount of carbonic acid formed, when under otherwise like conditions

* Compt. rend., 76, p. 22.
† *Ibid.*, 59, p. 232.
‡ Zeitsch. Biol., 14 (1878), p. 462.
§ Journ. Landw., 34 (1886), p. 233.

the water content of the soil is increased. For example experiments by the writer* gave the following results:

Proportion of water in soil ....per cent..	2.91	12.91	22.91	32.00
Carbonic acid in 1000 cc. of soil air........cc..	1.64	2.40	4.49	9.02

Although it must be inferred from these and other experiments that the decomposition of organic substances increases as water is added, still it must not be forgotten that addition of water beyond a certain amount retards the process by diminishing the ease of access of the oxygen of the atmosphere. In this case the carbonic acid can be formed only at the expense of the oxygen of easily reducible matter, and the oxidation process assumes a different character.

In consideration of the fact that the decomposition of organic substances is connected with the vital processes of organisms, it is not surprising that the temperature is of great importance. In experiments by Schlösing the oxidation of nitrogen was extremely slow at 5° C., quite marked at 12° C., reached its maximum at 37° C., and ceased entirely at 55° C. The combination of oxygen with carbon is subjected to the same law, as indicated by the following experiment of the writer, with a moist compost soil. The quantities of carbonic acid are those in the confined volume of air in which the soil was placed:

Temperatures.......................... degrees C..	10	20	30	40	50
Carbonic acid in 1,000 cc. of air ....cc..	2.80	15.46	36.24	42.61	76.32

The formation of carbonic acid increases considerably with increase of temperature, reaches its maximum at 50 or 60° C., and never completely ceases even at temperatures below 0° C., as other experiments have shown.

(To be continued.)

*Wollny: Forsch. Geb. agr. Physik, 4 (1881), p. 14.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

BOTANY.

A. C. TRUE, *Editor.*

Secondary effects of pollination, W. M. MUNSON (*Maine Sta. Report for 1892, pp. 29–58, pl. 1, figs. 16*).—Preliminary notes on the secondary effects of pollination considered under the following heads: (1) Immediate influence of pollen on the mother plant; (2) development of the ovary without fecundation of the ovules; (3) amount of pollen required for fertilization and the effects of pollination on the form and size of the fruit; (4) general influence of foreign pollen and miscellaneous observations. The author considers the change produced by contact of embryo sac and pollen tube, resulting in the vivifying of certain cells, as the primary object of fertilization and all others as secondary effects. The immediate influence of cross-fertilization upon the mother plant is somewhat restricted. The most important plants showing such effects are the pea, kidney bean, and Indian corn. Of corn the "sweet" varieties show the effect of foreign pollen most frequently. Experiments with cucurbitaceous plants, reported in Bulletin No. 25 of the New York Cornell Station (E. S. R., vol. II, p. 509), and with solanaceous plants seem to show no immediate effect of cross-pollination. Rosaceous plants are in dispute, many reported crosses lacking verification.

The ovary of certain plants may be developed without fecundation of the ovules, but no seed will be matured. This is especially true of egg-plant and cucurbits. This habit seems to be associated with a rapid and vigorous growth.

There is no relation between the amount of pollen borne by a plant and the amount required for the fecundation of its ovules or the number of seed produced, but the amount of pollen applied to the stigma and the development of ovary and ovules are in some cases very intimately associated. Experiments with tomatoes, reported in Bulletin No. 28 of the New York Cornell Station (E. S. R., vol. III, p. 91), show that

an insufficient amount of pollen will result in misshapen, smaller fruit, with fewer seeds than where an excess is applied to the stigma. The same facts, at least in part, pertain to some varieties of strawberries.

For most plants better results follow an excessive supply of pollen. The English Forcing cucumber when pollinated nearly always produces misshapen fruit. This the author says can be traced directly to the influence of the pollen, while Prof. Bailey, in Bulletin No. 31 of the New York Cornell Station (E. S. R., vol. III, p. 240), thinks it is due to individual plant variation rather than to any particular treatment.

The author thinks there is evidence pointing to the possibility of distinct effects from two male parents when their pollen is applied to the same stigma at different times. This point is now receiving special attention.

METEOROLOGY.

Meteorological observations, C. D. WARNER (*Massachusetts Hatch Sta. Meteorological Buls. Nos. 47 and 48, Nov. and Dec., 1892, pp. 4 each*).—Daily and monthly summaries of observations for November and December at the meteorological observatory of the station. The December number also gives a summary of observations for 1892, which, in brief, is as follows: *Pressure* (inches).—Actual maximum, 30.42, February 27, 9 p. m.; actual minimum, 28.77, February 12, 4 a. m.; mean reduced to sea level, 26.983; annual range, 1.65. *Air temperature* (degrees F.).—Maximum, 93.5, July 27; minimum, 0, January 17; mean, 48.5; annual range, 93.5; maximum mean daily, 82.5, July 26; minimum mean daily, 9, December 24; mean maximum, 55.7; mean minimum, 41.1; mean daily range, 14.6; maximum daily range, 34.5, February 18; minimum daily range, 1.6, December 14. *Humidity.*—Mean dew-point, 39.2; mean force of vapor, 4532; mean relative humidity, 67.7. *Precipitation.*—Total rainfall or melted snow, 28.61 inches; number of days on which .01 inch of rain or melted snow fell, 108; total snowfall in inches, 42½. *Weather.*—Mean cloudiness observed, 49 per cent; total cloudiness recorded by the sun thermometer, 2,220 hours, or 50 per cent; number of clear days, 123; number of fair days, 109; number of cloudy days, 134. *Wind* (prevailing direction).—NW., 14 per cent; N., 13 per cent; SW., 13 per cent; S., 10 per cent; total movement, 54,720 miles; maximum daily movement, 436 miles, March 2; minimum daily movement, 16 miles, January 18; mean daily movement, 149.5 miles; mean hourly velocity, 6.2 miles; maximum pressure per square foot, 20½ pounds—64 miles per hour, March 11, 3:30 p. m. *Bright sunshine.*—Number of hours recorded, 2,261. *Mean ozone*, 36 per cent. *Dates of frost.*—Last, May 10; first, September 30. *Dates of snow.*—Last, April 10; first, November 5.

FERTILIZERS.

W. H. BEAL, *Editor*.

Inspection of fertilizers in Maine (*Maine Sta. Report for 1891, pp. 1–20*).—Tabulated analyses of 64 samples of commercial fertilizers inspected during the year 1891, with schedule of trade values of fertilizing materials, and a brief report on tests of the solubility of the nitrogenous matter in fertilizers in acid pepsin solution. The details of the method of pepsin digestion are given in the Annual Report of the Station for 1889, p. 30 (E. S. R., vol. II, p. 644).

In the 24 samples examined by this method the solubility of the organic material varied from 35 to 78 per cent.

In the case of several brands the figures are such as to cause grave doubts as to whether the manufacturers are not using what are regarded as low-grade ammoniates—that is, ammoniates coming from such materials as hoof, horn, leather, etc.—which we have reason to suppose will decompose slowly in the soil and are therefore poorly adapted for use with quickly growing plants. It is at least safe to affirm that with a large number of these fertilizers the solubility of the organic matter comes far short of that which dried blood, cotton-seed meal, dried flesh, and similar materials are known to have.

Inspection of fertilizers in Maine (*Maine Sta. Report for 1892, pp. 1–25*).—Tabulated analyses of 74 brands, representing 190 samples of commercial fertilizers inspected during 1892, besides analyses of 3 samples of muck and 1 each of feldspar, fish pomace, seaweed, cedar ashes, and ashes from burned muck. A schedule of trade values of fertilizing materials during 1892 is given, with remarks on valuation and methods of buying fertilizers.

In the case of 64 brands of fertilizers analyzed, the average selling price as given to the station agent was $34.08. The average station valuation of the same brands was $24.07, or $10 less than the selling price. * * * In the case of 17 brands sold by two leading manufacturers, the average selling price is $36.38 and the average station valuation $27.05, a difference of $9.33, or 34.5 per cent of the cost in the market.

It appears, then, that even with the manufacturers most largely patronized, there is a margin of over $9 between what farmers are actually paying for a ton of superphosphates and the cost of the same amount of plant food in unmixed goods when bought in the large markets. * * *

The disadvantages of the present method by which our farmers are largely obtaining their fertilizers may be summarized as follows:

(1) It is a costly system of selling due to the large expense for agents and the great loss on credits.

(2) It is a system which unfortunately seems to be accompanied by so many unfair arguments and so much of distortion of facts that the farmer is to some extent hindered rather than aided in gaining clear ideas of true facts.

(3) And so this is a system which leads the farmer to consider chiefly the rival claims of competing manufacturers rather than to study his own needs and then to buy such plant food as is adapted to his wants.

If farmers are to purchase commercial plant food, great advantages would result in a change to the following system:

(1) The buying of plant food as such under proper names, thus avoiding the confusion and uncertainty attending the purchase of an ever-increasing number of brands whose names mean little or nothing.

(2) The purchase of fertilizers in large quantities for cash.

HORTICULTURE.

A. C. TRUE, *Editor*.

Tomato notes for 1892, L. H. BAILEY and L. C. CORBETT (*New York Cornell Sta. Bul. No. 45, Oct., 1892, pp. 189–219, figs. 4*).

Synopsis.—A report on experiments in continuation of those recorded in Bulletin No. 32 of the station (E. S. R., vol. III, p. 405). The nature of the experiments and their main results may be briefly indicated as follows: (1) Nitrate of soda applied once early in the season gave better results than divided applications continued until late in the season; (2) nitrate of soda alone gave the largest yield before frost and the largest total crop on fairly good soil; (3) the relation of variety to fertilizing is not clearly indicated by the experiments thus far made; (4) early setting (May 9) was better than late setting; (5) seeds for the main crop should be sown in March under glass; (6) transplanting should be done at least twice; (7) pot-grown plants did better than flat-grown plants; (8) the results of comparisons of seedlings and cuttings were conflicting; (9) there was no gain from using seeds from early fruits; (10) seeds from a mature fruit gave earlier and better yields than those from an immature fruit; (11) "leggy" plants when layered at planting gave relatively large yields; (12) shearing off the tops of plants did not materially affect the yield; (13) hilling did not give favorable results; (14) the results from trimming during three years were indecisive; (15) single stem training increased yield and earliness; (16) fruit rot apparently was not influenced by method of culture or variety; (17) Southern blight has appeared in New York; (18) of the new varieties tested in 1892, none proved better than some older varieties.

Quick and slow fertilizers (pp. 189–194).—The experiments in 1892 confirmed those of 1891 "in showing that tomatoes need a fertilizer which is quickly available early in the season. Fertilizers applied late or which give up their substance late in the season give poor results because they delay fruitfulness and the plant is overtaken by frost before it yields a satisfactory crop. This fact is no doubt the origin of the widespread opinion that the tomato crop is injured by heavy manuring." Notes and tabulated data are given for an experiment in which nitrate of soda was applied once early in the season and four times during the season. In the following table are given the yield until frost (October 1), and the total yield, including all the fruits on the plants after they were killed by frost. Each plat contained 15 plants.

Applications of nitrate of soda.	Average number of fruits per plant.		Average weight of crop per plant.		Average weight of individual fruits.	
	To frost.	Total.	To frost.	Total.	To frost.	Total.
			Lbs.	*Lbs.*	*Oz.*	*Oz.*
(1) Once, June 20, 3 pounds	24.2	53.3	10.0	17.8	6.6	5.3
(2) Four times, June 20 and 28, July 11 and 27, 12 ounces each	20.0	51.6	8.7	16.6	6.9	5.1
(3) Four times, June 20, July 21, August 8 and 26, 12 ounces each	15.2	44 2	6.6	14.4	6.9	5.2
(4) No fertilizer	15.8	31.1	5.8	9.8	5.9	5.3

The first fruits were about equally early on all the fertilized plats, but after the first two pickings the plat receiving the single application gave the largest returns, and this advantage was maintained throughout the picking season. Large pickings were also obtained relatively early on the plat which received the four applications ending with July 27. In all cases the nitrate of soda increased the yield as compared with no fertilizer. The soil used in these experiments was fairly good, so that previous results, which indicate the necessity for potash and phosphoric acid as well as nitrogen in a fertilizer for tomatoes, especially on poor soil, are not contradicted.

General fertilizer tests (pp. 195, 196).—Nitrate of soda, boneblack, and muriate of potash were applied, singly and in combination, on 7 plats containing six plants each, on "fairly good gravelly soil." Nitrate of soda alone gave the largest yield before frost and the largest total crop, and a complete fertilizer gave next to the largest total crop. In all other cases the yield fell below that on the plat where no fertilizer was used.

Relation of variety to fertilizing (pp. 196, 197).—"In 1891 [on poor soil] our test seemed to indicate that the highly improved varieties give the greatest response to fertilizing in the number of fruits produced, although the little-improved sorts gave greater proportionate increase in total weight of crop. In 1892 [on good soil] these results were not verified, save that the little-improved sorts gave least increase in number of fruits."

Early and late setting (pp. 197–199).—Three lots of Ignotum tomatoes, each containing 12 vigorous and stocky plants, were set in the field May 7 and 9 and June 1. The first lot, though injured by frost, nearly equaled that set June 1. The best results were from planting May 9. These results confirm those of two previous years.

Early and late seed-sowing (pp. 199–202).—Seeds of Ignotum tomatoes were sown under glass from January 19 to March 14.

The earliest sowings gave the earliest fruits, but the largest yield came from the latest sowing, March 14, the difference in favor of this late sowing being very marked. In 1889 our tests showed that seeds sown in April and May gave poorer results than those started in March. It seems to be true, therefore, that the best time to sow tomato seeds in this latitude for the main crop, if one has a forcing-house or a good hotbed, is about the middle of March.

Few and several transplantings (p. 202).—"Earlier fruits were obtained from plants which had been three times transplanted in the house than from those transplanted only once. In 1891 greater yields were obtained from two transplantings than from either one or three. Much, no doubt, depends upon the vigor and age of the plants, but it is certainly safe to say that in all ordinary cases plants which are started in March should be transplanted at least twice."

Flat-grown vs. pot-grown plants (pp. 202, 203).—"Plants grown in pots, one lot transplanted twice and one lot thrice, gave earlier and heavier yields than plants similarly transplanted into 'flats' or shallow gardener's boxes."

Seedlings vs. cuttings (pp. 203–205).—"Late in winter strong cuttings were taken from the auxiliary shoots of a seedling plant of the peach type and were set out regularly in our tomato house."

March 29 and May 3, cuttings from the original plant were planted, together with seeds from fruits on the same plant. May 3, cuttings from the first cuttings mentioned above were also planted.

"In 1892 cuttings gave earlier and heavier yields than seedling plants. In 1890 the cuttings gave the poorer yields, while in 1891 the results were mixed. These variations in results no doubt depend upon some condition of the plants or some factor in our handling which we have not yet discovered. Cuttings of cuttings gave better yields than one-generation cuttings, both last year and this."

The cuttings of cuttings did not reproduce the parent type.

Products of early and late fruits (pp. 205, 206).—Seeds from a house plant of a Currant-Ithaca hybrid, from fruits ripened December 3, 1891, and March 18, 1892, were sown at the same time. The largest yields were from the seeds of the late fruit. The first ripe fruits were picked on the same day from plants from both the early and late fruits. "Similar results have been obtained before by ourselves and others, and it is probably safe to say that no gain is secured by selecting seeds from early or first ripe fruits without giving any attention to the character or habit of the plant as a whole."

Products of mature and immature fruits (p. 207).—"Plants grown from seeds from a fully ripe fruit [of a house plant of the Brick tomato] gave earlier and better yields than other plants raised from a fully grown but unripe fruit from the same plant."

"Leggy" plants (pp. 207, 208).—"'Leggy' or 'drawn' plants were set at the ordinary depth and half the stem was laid and covered in a shallow trench. These gave much larger yields than normal or stocky plants started and planted at the same time. Last year opposite results were obtained; but at that time the plants were so badly drawn that they were unable to stand alone. This year the leggy plants were about 20 inches high, but while slender they were still stiff and vigorous when put in the field. It is safe to conclude that if one has leggy plants he should layer them when planting."

Shearing young plants (pp. 208, 209).—Plants which had their tops sheared off in place of the last transplanting, May 17, matured fruits later than normal plants transplanted at the same time, but gave somewhat larger yields before frost.

Hilling (p. 209).—"Two plats of 28 good Ignotum plants each were set aside for a test of the value of hilling tomatoes, half of each plat being hilled July 2, the remaining halves receiving common level cultivation. The soil was drawn up around the base of the plant to a height of 6 inches, as potatoes are hilled. * * *

The results are conflicting, although on the whole the normal or check plants gave rather the better results. In earliness there was no appreciable difference. This hilling experiment was first made last year, it having been urged upon us by a gardener who thinks that hilling gives greatly increased yields, but in both years we have found no advantage in it."

Trimming (pp. 209, 210).—On 3 plats of 12 plants each of Ignotum tomatoes, the plants were trimmed by "heading-in the main shoots to the first fruit which had attained the size of a marble." The trimming was done at different dates. The early trimmed plants gave considerably smaller yields than the late-trimmed or untrimmed plants. On the whole the results in 1892 were not favorable to trimming. The results for three years are indecisive.

Single stem training (pp. 210, 211).—"A number of Ignotum plants were set 1 foot apart in rows, and each plant was tied up to a perpendicular cord, but one stem or stalk being allowed to grow in each case." These plants gave decidedly larger yields per square foot of land than untrained plants and the crop was earlier. These results agree with those of the previous year.

Fruit rot (pp. 211–213).—Tabulated data of the percentages of rot observed in 1892 on tomatoes grown under various conditions as regards manuring and culture, and on different varieties do not show that the rot was influenced by methods of culture or varieties. The rot was not very prevalent during the season.

Southern or field blight (pp. 213–215).—A brief illustrated account of a disease which affected the leaves of tomato plants at the station and elsewhere in the State. It is probably identical with the blight described in Bulletin No. 19 of the Mississippi Station (E. S. R., vol. III, p. 702). "It is characterized by a yellowing, curling, and drying of the leaves, which finally become black and dead. No remedy is known, but rotation of crops will probably check it."

Varieties (pp. 215–217).—Notes and tabulated data are given for 6 varieties tested in 1892. Nichol No. 5, Royal Red, and Belmont gave promising results, but were no better than some older varieties. Ignotum is still considered the best for the main crop. The following German varieties were tried:

Paragon, King Humbert, Yellow Plum, Earliest Dwarf, Monstrous Giant, and French Upright. Of these, only the Paragon would be considered of any value in America

for market cultivation. The Earliest Dwarf and Monstrous Giant, which are second best, represent the old angular sorts which we have long since outgrown.

[A German striped variety is described and illustrated.] It belongs to the old angular type of tomatoes. The ground color is a deep clear red, and this is overlaid with splashes and bands of bright orange. Sometimes the orange is the prevailing color and the red takes the position of stripes. The fruit is very striking and its quality is also good. In general productiveness and merit it will probably rank fully as good as General Grant, which was popular a few years ago. We first grew this German striped tomato in 1887. Striped or variously marked tomatoes occasionally appear in plantations, but this is the only one which we have ever known to be permanent, or to "come true to seed" for any length of time. A striped tomato appeared in an Ithaca garden three or four years ago, but it ran out in one or two generations.

The Currant-Ithaca hybrid which was described and figured last year was grown again this year from seeds and cuttings from one of the original plants. Among 36 plants there were no reversions to either parent, although about one-third of them gave larger fruits than the others. All the plants were very productive and vigorous, and the fruit is very handsome.

Grapes, S. M. TRACY and F. S. EARLE (*Mississippi Sta. Bul. No. 22, Sept., 1892, pp. 16*).—An account is given of the station vineyard, and of the methods of culture, trellising, and pruning employed there, together with descriptive notes on 27 varieties of grapes which are being tested. There are also a brief account of tests of varieties at the substation at Ocean Springs, and notes on the bitter or ripe rot of grapes (*Melanconium fuliginium*). The station vineyard is on well-drained yellow loam underlaid with heavy red clay. Before planting a large quantity of bones were put into the holes prepared to receive the vines. The first vines were planted in March, 1888, and annual additions have been made to the vineyard. Both vertical and horizontal trellises have been used at the station and substation. The horizontal trellises have proved most satisfactory.

"Our reasons for preferring the horizontal trellis are that it makes pruning much more simple and easy; that it keeps the lower part of the vine free from sprouts and branches, which would interfere with cultivation; that it affords much greater protection to the growing and ripening fruit; that it holds the fruit where it can be easily reached in spraying, and that it gives partial immunity from the attacks of fungous diseases."

Bordeaux mixture and eau celeste have been thoroughly applied during four years, but have not prevented the development of anthracnose and ripe rot. The latter "continues to develop on the fruit after it is picked, and is aggravated by the wet weather which occurs in July, when the grapes are picked." Covering the clusters with paper bags has effectively preserved the fruit from fungous attacks. The tests of varieties have proceeded far enough to show that grapes may be successfully grown in the State, even on rather low ground. The European varieties start too early and are subject to mildew.

"Varieties well adapted for general cultivation in the coast region

are Ives, Champion, Delaware, Niagara, and Concord; for cultivation further North we recommend Moore Early, Delaware, Brilliant, Niagara, Eaton, Triumph, Rommel, and Herbemont."

Mulberries, L. H. BAILEY (*New York Cornell Sta. Bul. No. 46, Nov., 1892, pp. 223–243, figs. 9*). "The mulberry is grown for fruit, ornament, hedges, and small timber, as well as for silk. It merits more general attention, especially as a fruit-bearing tree. The fruit of some varieties is excellent for dessert, and it may be used for making jellies and preserves. It is also good food for poultry and for swine." The history of mulberry cultivation in this country is briefly given. The obscurity of the botanical relations of the different varieties of mulberries is pointed out and the following classification of American varieties is proposed:

(1) White mulberry (*Morus alba*, Linn.)—varieties, New American, Trowbridge, Thorburn; (*a*) Russian mulberry (*Morus alba*, var. *tatarica*, Loudon)—varieties, Victoria, Ramsey White, Teas Weeping; (*b*) Nervosa mulberry (*Morus alba*, var. *venosa*, Delile). (2) Multicaulis (*Morus lactifolia*, Poiret)—varieties, Downing, Spaulding, Rives. (3) Japanese mulberry (*Morus japonica*, Audibert). (4) Black mulberry (*Morus nigra*, Linn.)—varieties, Black Persian, Black Spanish. (5) Red or native mulberry (*Morus rubra*, Linn.)—varieties, Johnson, Hicks, Stubbs; (*a*) Lampasas mulberry (*Morus rubra*, var. *tomentosa*, Bureau). Unclassified varieties, Bigert, Paine, Black American. The groups and varieties are defined and described.

(1) *The white mulberry group* (*Morus alba*, Linn.).—Leaves light green, rather small, smooth or very nearly so above and often shining, the veins prominent beneath and whitish, variously lobed or divided, the basal lobes unequal, the teeth large and for the most part rounded or nearly obtuse, the branches gray or grayish yellow. The white mulberry is supposed to be a native of China. It has been cultivated from the earliest times, chiefly for feeding the silkworm. It is a frequent tree along roadsides and in the old yards in the Eastern States, where the trunk sometimes attains a diameter of 2 feet. This half wild form usually has rather small, rounded, shining leaves, with very large, rounded teeth, and bears little whitish or violet fruits, which are very sweet. Sometimes the fruits are an inch long, but they are oftener only half that length, and I sometimes find trees upon which the fruits are barely a quarter of an inch in length. Now and then a tree bears fruits nearly or quite black. Birds, poultry, and hogs are fond of these mulberries. The trees are usually very thick topped and bushy growers, but occasionally one is seen which when young has branches as straight and trim as a Northern Spy apple. These half wild trees are seedlings, and this accounts for their variability. If the best ones were selected and grafted onto others we might find trees worthy of orchard culture. * * *

(a) *The Russian mulberry sub-group* (*Morus alba*, var. *tatarica*, Loudon, *Morus tatarica* of Linnæus).—This is a hardy type of *Morus alba*, which was introduced into our Western States during 1875–'76–'77 by the Russian Mennonites. It scarcely differs from the type of *Morus alba* in botanical characters, and perhaps should not be kept distinct, even as a botanical variety. As commonly seen, it is a low growing, very bushy topped, small tree, with small and much lobed leaves. The fruit is usually very small and insipid, and varies from creamy white to violet, deep red and almost black. * * *

The Russian mulberry is commonly propagated from seeds and it is therefore very variable. * * * Save an occasionable sport, it has no merit for fruit, unless it serves to attract birds from cherries and other fruits; but even this is a problematical advantage. In the East at least it has no merits for timber, as it is too small and grows too slowly. In the prairie soils of the West it often grows into respectable post timber in a short time. * * *

But the chief merit of the Russian mulberry appears to be its value as a hedge plant in cold regions.

(b) *The Nervosa sub-group* (*Morus alba*, var. *venosa*, Delile, *nervosa* of Bon Jardinier and horticulturists).—The Nervosa mulberry is a strange monstrosity of the white mulberry. Its leaves are contracted and jagged, and are very strongly marked with many white veins. It bears a fruit a half an inch long. Among the horticultural curiosities this tree should find a place, and it is to be regretted that it is not grown by our nurserymen. Its ornamental value is considerable, especially when striking effects are desired.

(2) *The Multicaulis group* (*Morus latifolia*, Poiret, *M. multicaulis* of Perrottet, *M. alba*, var. *multicaulis* of Loudon).—A strong-growing small tree or giant shrub, with dull, roughish and very large long-pointed leaves, which are seldom or never prominently lobed, and which are often convex above, bearing black sweet fruit.

(3) *The Japanese group* (*Morus japonica*, Audibert, *M. alba*, var. *stylosa* of Bureau).—Leaves usually large, dull, rather thin, long-pointed, the rounded teeth very large and deep, or the margin even almost jagged, the leaves upon the young growth usually deeply lobed. This species has been introduced very lately and it has not yet fruited in this country, so far as I know. It is tender in the North when young. The fruit is described as short-oblong and red.

(4) *The black mulberry group* (*Morus nigra*, Linn.).—Leaves dark, dull green, rather large, tapering into a prominent point, commonly very rough above, usually not lobed, the base equal or very nearly so upon both sides, the teeth rather small and close, the branches brown. The black mulberry is a native of Asia, probably of Persia and adjacent regions. It is the species which is cultivated in the Old World for its fruit. In America it is very little grown. It is not hardy, except in protected places, in New England and New York. * * *

There must be large regions in this country which are congenial to the true black mulberry, and it is strange that it is so little known. The fruit of this species is much larger than that of any other, and it possesses an agreeable sub-acid flavor. * * *

(5) *The red or native mulberry group* (*Morus rubra*, Linn.).—Leaves usually large, very various, those on the young shoots deeply lobed, with very oblique and rounded sinuses, in the base of which there are no teeth; the upper surface rough and the lower one soft or variously pubescent; the teeth medium or comparatively small and either rounded or bluntish. The native mulberry is generally distributed from western New England to Nebraska and southward to the Gulf, being much more abundant and attaining a larger size in the South. The fruit is deep red, or when fully ripe, almost black, variable in size, often very good, nearly always having an agreeable slight acidity. This native mulberry has been tried for the feeding of silk worms, but with indifferent success. * * *

The red mulberry is the largest tree of the genus. It often attains a height of 70 feet in the South. The timber is much used for fence posts, fencing and light woodwork.

[The following summary is given in the bulletin:] Sixteen varieties are mentioned in this paper as fruit-bearing kinds: New American, Trowbridge, Thorburn, Victoria, Ramsey White, Downing, Spalding, Black Persian, Black Spanish, Johnson, Hicks, Stubbs, Lampasas, Bigert, Paine, and Black American. Of these the most prominent are New American, Downing, Black Persian, Hicks, and Stubbs.

The New American is recommended for the Northern States. Downing is almost

out of cultivation in the North, but the New American commonly passes under this name. Black Persian is occasionally grown in the South and on the Pacific coast, but it seems to be ill-adapted to our conditions. Hicks is a heavy bearer, of indifferent quality, but valuable for poultry and for swine, especially in the South, where it has been most thoroughly tested. Stubbs is perhaps the most profuse bearer of all, and the fruit is large and excellent in quality.

The other varieties and types are grown for shade, ornament, and timber. The most unique of these varieties are the Nervosa and Teas Weeping. The Russian type is valuable for ornamental hedges, especially in the prairie States, for planting sparingly as single specimens or in groups as ornamental trees, and for small timber on the prairies. The fruit is usually worthless. This type has already given three named varieties of more or less merit, Victoria, Ramsey White, and Teas Weeping. * * *

American varieties of fruit-bearing mulberries have developed along independent lines, having come chiefly from *Morus alba* and *M. rubra*, while the fruit mulberry of history is *M. nigra*.

The native mulberry (*Morus rubra*) has given us some of the most important varieties, and as it is naturally variable and adapted to our various climates, it is the probable progenitor of the American mulberries of the future.

The mulberry is easily grown upon ordinary soils, it is often tender in the North during the first two or three years.

The mulberry is propagated by cuttings of the mature wood or the roots, by root and crown-grafting, and by budding with dormant buds in the spring.

Experiments with vegetables and fruits, 1891, W. M. MUNSON (*Maine Sta. Report for 1891, pp. 81–99, plates 3*).

Synopsis.—The horticultural department of the station was organized in 1891. A new forcing house is described, with illustrations. The principal lines of work are "the study of effects of climate on plant variation, effects of pollination, studies of the eggplant and the pepino, the amelioration of native fruits by selection and crossing, methods of culture of certain garden vegetables in the field and under glass and methods of combating orchard pests." In experiments with cabbages good results were obtained from frequent transplanting. Jersey Wakefield cabbages gave best results with deep setting. With tomatoes early setting and trimming gave good results.

Tests of varieties of fruits were begun at the station in 1889, but there was no organized department of horticulture until 1891, when the author took charge of the work. A new forcing house, 20 by 180 feet, is described and illustrated.

The framework is of cypress and the walls are of grout, while the building is heated by hot water. The house is divided in the center by a glass partition, and the hot water pipes have been so arranged that one part may be kept at a much lower temperature than the other. The warm house is arranged for bottom heat and the cool house for overhead heat.

At the present time the warm house is used for tomatoes, cucumbers, and beans while the other is devoted to lettuce, radishes, cauliflowers, and other plants requiring the lower temperature.

The building in connection with the forcing house was erected during the year at a cost of about $1,000, a part of the expense being borne by the college. The building contains, besides the furnace room and a room for the smaller garden tools, a general laboratory and work room, a small office, a room for herbarium work, and a well-appointed photographic studio. In all of our work photography is made to play an important part as a means of preserving accurate records.

The grounds devoted to this division include about 10 acres of land of varied character. More than half of this area is devoted to fruit culture. The apple orchard contains about 115 varieties, 52 of which are Russian varieties obtained from Prof. Budd, of Iowa. There are also 23 varieties of pears, 30 of plums, and 12 of cherries; also quinces 2 varieties, blackberries 9 varieties, raspberries 13 varieties, currants 7 varieties, gooseberries 3 varieties, strawberries 17 varieties. As the college campus is under the supervision of the writer a considerable amount of experimental work is done with ornamental plants on other areas.

Cabbages (pp. 83–87).—Experiments with 4 varieties, grown in flats and in pots until set in the field, in general indicated that frequent transplanting, especially in pots, is beneficial.

Jersey Wakefield cabbage set deep at each transplanting gave better results than when set shallow. Brief descriptive notes are given on 7 varieties. Jersey Wakefield, Brunswick, Early Summer, and Flat Dutch are recommended for general culture. Nonesuch is a promising new variety.

Tomatoes (pp. 87–93).—Plants of the Perfection variety were set in the field May 18 and 30, and June 8. A frost on May 31 did some injury, but the earliest-set plants gave the heaviest yield during August and the heaviest total yield. Trimming plants of the Perfection and Chemin Market varieties, July 24, August 8, and September 5, increased earliness and yield. Experiments with Golden Queen indicate that by selection it may be possible to secure a "yellow fruit with a blush cheek." Brief descriptive notes are given on 17 varieties. Ignotum, Perfection, Beauty, and Golden Queen are recommended for general use. Long Keeper and Stone are promising new varieties.

Fruits (pp. 94–99).—The winter of 1890–'91 was unusually cold, and fruit trees suffered severely. In the station orchard Clapp Favorite, Flemish Beauty, and Sheldon pears, and Duane Purple, German Prune, Moore Arctic, Quackenbos, and Yellow Egg plums were not injured. Additions have been made to the varieties of orchard and small fruits under test at the station. Experiments under the direction of the station have been begun at Perham, Aroostook County, with a view to finding hardy varieties suitable for the northern part of the State.

Tests of fruits, nuts, and vegetables at the South Haven Substation, 1892, T. T. LYON (*Michigan Sta. Bul. No. 88, Dec., 1892, pp. 31*).—The third year's report on tests of varieties of orchard and small fruits, nuts, rhubarb, and asparagus. Previous reports were issued as Bulletins Nos. 67 and 80 of the station (E. S. R., vol. II, p. 353; III, p. 700). Climatic conditions materially interfered with the success of the tests in 1892.

Strawberries.—Tabulated data are given for 150 varieties, with brief descriptive notes on 16 of the most desirable varieties. Beder Wood, Bubach, Crescent, Enhance, Haverland, and Parker Earle continue to be among the best varieties. Mrs. Cleveland, Warfield, and Michel Early have not been decided successes at the station. Eclipse, Flor-

ence, Gem, Governor Hoard, Great Pacific, and Woolverton are promising varieties. Manchester has excellent qualities, but has a tendency to overproduction.

Raspberries.—Tabulated data are given for 2 varieties of *Rubus idæus*, 7 of *R. neglectus*, 38 of *R. occidentalis*, and 11 of *R. strigosus*. Japanese wine berry (*R. phœnicolasius*) has attractive foliage and flowers, but its fruit is of "no practical value." An objection to its use as an ornamental plant is its habit of spreading by suckers.

Blackberries and dewberries.—Tabulated data for 30 varieties of blackberries and 2 of dewberries.

Currants.—Tabulated data for Crandall, 6 black, and 17 white and red varieties. Crandall seems to be exempt from attacks of insects and fungi, but its skin is thick and tough even after cooking.

Gooseberries.—Tabulated data for 13 varieties. Houghton and Pale Red are productive and will endure neglect, but are of small size. Downing is popular as a market variety. Experience so far in Michigan indicates that European varieties should be planted only where the conditions are exceptionally favorable to their growth.

Cherries.—Tabulated data for 20 Heart and Bigarreau (*Prunus avium*) and 42 Duke and Morello (*P. cerasus*) varieties.

Mulberries.—Brief notes on 5 varieties.

Service berries.—Brief notes on 3 varieties. The cultivated varieties thus far do not seem to be better than the native variety.

Peaches.—"To the 149 varieties already planted, 61 were added last spring." The season was so unfavorable that no fruit was produced by the varieties which bloomed. Only brief general notes are given.

Plums.—Eighty-four varieties are now on trial, 40 of which bloomed in 1892, but no fruit was produced.

Grapes.—Tabulated data are given for 98 varieties and brief descriptive notes on 36 varieties.

Pears.—Eighty-one varieties have been planted.

Apples.—One hundred and eighty-eight varieties have been planted.

Quinces.—The following varieties bore fruit in 1892: Rea, Meech, Champion, and Orange.

Figs.—Experiments with cuttings of Brunswick figs are in progress.

Nuts.—Brief notes on several varieties of chestnuts, chinquapins, pecans, walnuts, almonds, filberts, and hazelnuts.

Rhubarb.—Linnæus is judged to be the best variety for home or market use.

Asparagus.—Palmetto has proved superior in size and productiveness. The results of planting crowns from old plantations have not been satisfactory.

SEEDS.

WALTER H. EVANS, *Editor.*

Distribution of seeds and plants, E. J. WICKSON (*California Sta. Bul. No. 98, Dec. 15, 1892, pp. 4*).—A list of seeds and plants which the station is prepared to furnish applicants within its own State. Among the plants new to the State are three Australian trees of promising economic value, *Acacia leptopheleba*, *A. decurrens*, and *Eucalyptus citriodora* or lemon-scented gum. Seed of cañaigre (*Rumex hymenosepalus*) is offered those wishing to grow this important tannin-producing plant. Crimson clover for green manure and winter pasture promises well. The flat pea (*Lathyrus sylvestris*) has been the subject of considerable investigation and is highly recommended for that region. It withstands drouth well and is of rapid growth. The following analysis made by the station chemist is compared with that made in England by Hope:

Analysis of Lathyrus sylvestris.

Whole plant.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Before blooming (California)	63.48	3.18	8.18	9.76	13.77	1.63
After blooming (England)	58.63	3.09	7.44	12 21	16.58	2.05

These analyses indicate that the flat pea has a higher nutritive value than alfalfa.

Another new forage plant, *Sida elliottii*, is mentioned as very promising for heavy clay soils without irrigation.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Some bean diseases, S. A. BEACH (*New York State Sta. Bul. No. 48, n. ser., Dec., 1892, pp. 308–333, figs. 9*).—This bulletin treats of (1) anthracnose of beans and its treatment, (2) blight of common beans, (3), blight of Lima beans, and (4) bean rust.

Anthracnose of beans (pp. 308–329).—*Colletotrichium lindemuthianum*, described in the Annual Report of the New Jersey Stations for 1891 (E. S. R., vol. IV, p. 52), is discussed in a popular manner under the following heads: Distribution and character of the disease, diseased seed, appearance on young plants, appearance on leaves, appearance on pods, appearance of spore masses, experiments in treating bean

anthracnose, treatment of diseased seed, comparison of yield from healthy and diseased seed, spraying diseased plants, and spread of disease on gathered pods. There are also a more technical description and discussion of the fungus, details of experiments, and the bibliography of the subject.

The microscopic characters are briefly given. During the past year this disease was very prevalent in the State. Reports received from nearly every county in the western portion of the State show its presence in 62 per cent of them, and the estimated loss to the crop due to anthracnose varies from less than 20 to almost 100 per cent.

Seed was soaked in fungicides, as recommended in the Annual Report of the New Jersey Stations for 1891 (E. S. R., vol. IV, p. 52). Tests were made in the greenhouse by soaking the seed in water at 140° F. for five minutes, in water at 130° F. for fifteen minutes, in Bordeaux mixture for one hour, in ammoniacal copper carbonate for one hour, and in a solution of potassium sulphide for one hour. The disease was present in all cases, but the hot water gave the greatest freedom from it. In the field experiments, hot water, copper sulphate, and corrosive sublimate solutions were tested. The water was kept at 120° F. for fifteen minutes and at 130° for five minutes. Iron and copper sulphate (1 ounce to 1 gallon of water) and corrosive sublimate ($\frac{1}{8}$ ounce to 1 gallon of water) were also used. The relative results may be expressed as follows:

Results of treatment for anthracnose of beans.

	Stand secured.	Marketable yield.	Yield of poor beans.
Untreated seed	100	100	100
Hot water	43	84	88
Copper sulphate	21	28	136
Iron sulphate	88	71	132
Corrosive sublimate	28	19	81

This table shows that instead of the expected benefit from treating the seed before planting, there was serious injury done.

Equal quantities of carefully selected seed and ordinary or supposed diseased seed were grown, the pods gathered as snap beans, and a record kept for the season. The results obtained were as follows, the selected seed being graded as 100 per cent in each case:

	Stand of plants.	Number of pods.	Weight of pods.	Damage to foliage by disease
Healthy seed	100	100	100	100
Diseased seed	84	91	83	108

The difference was more marked early in the season, as the disease made a severe attack upon the plants from healthy seed as the season advanced.

Spraying the plants with Bordeaux mixture was found to be highly advantageous. The formula used was 2 pounds copper sulphate, $1\frac{1}{3}$ pounds freshly slaked lime, 30 gallons water, and enough soap to make a good suds. Cupric borate and cupric polysulphide were also used, but they injured the foliage.

Blight of beans (pp. 329–331).—This disease seems to be of bacterial origin, and in some cases is even more destructive than the anthracnose. It attacks every part of the plant, and is followed by numerous saprophytic fungi, which finish the work begun by the bacteria. The ripened seeds are discolored by the disease and wrinkled or disfigured with rough spots, and should be rejected in planting, as it is probable the blight may be communicated to the following crop from diseased seed. The disease will be a subject for future investigation and report.

Blight of Lima beans (p. 331).—This disease is due to bacteria, and the germ has been isolated by means of plate cultures. Inoculations produced the characteristic spots, while similar punctures in which no virus was placed showed no signs of decay. The germ grew less readily on pods of wax and kidney beans and had but slight effect upon seedlings of *Phaseolus vulgaris* when applied to the unbroken epidermis. There is evidence that diseased seed propagate the disease and only healthy seed should be planted.

Bean rust (pp. 331–333).—A description of the disease of the leaves, petioles, and stems caused by *Uromyces phaseoli*. The pods are seldom attacked and but little injury is done to them.

On the foliage the bean rust first forms little brown spots nearly circular in out line and about as large as pin heads. These break out all over the leaf on either surface, and the spores produced in them are soon discharged as a rusty brown powder. After an indefinite time these spots change from brown to black and produce spores of larger size and different shape and texture.

It frequently happens that one leaflet is sprinkled with brown spots while its companion on the same leaf stalk is covered with black spots, or both kinds of spots may be found on one leaflet. This is not strange, since the different-colored spots represent different stages of the same disease. The fungus grows inside of the leaf for some time before the rust spots break out, and the need of treating is not realized until the spots appear.

No experiments have been tried for controlling this disease. It probably winters in the leaves.

Specimens of the fungus were submitted to Prof. Atkinson, who reported the determination and synonymy.

Treatment of potato scab, S. A. BEACH (*New York State Sta. Bul. No. 49, n. ser., Jan., 1893, pp. 1–13, figs. 2*).—Experiments were conducted during 1892 with potato scab (*Oöspora scabies*), described in the Annual Report of the Connecticut State Station for 1891 (E. S. R., vol. III, p. 772), for the purpose of investigating the following questions: "(1) To what extent can potato scab be prevented by treating the seed with fungicides? (2) Is spraying the seed and surrounding soil as effective in preventing scab as soaking the seed in the fungicide before

planting? (3) What are the comparative merits of different fungicides for the prevention of scab?"

The experiments were all performed with scabby seed. One portion was planted in infected soil where the cultivation of potatoes had been abandoned on account of the scab, and a similar lot in soil supposed to be free from infection. In each experiment half of the seed was soaked for one and one-half hours in the fungicide and the other half was sprayed. The method of spraying was as follows: The freshly opened furrow was well sprayed; into this were placed the seed potatoes and all again sprayed, and then covered. The usual checks were employed in each experiment. The fungicides tested were, (1) copper sulphate or blue vitriol; (2) iron sulphate or copperas; (3) zinc sulphate or white vitriol; (4) eau celeste; (5) Bordeaux mixture; (6) mercuric chloride or corrosive sublimate, and (7) ammoniacal copper carbonate.

The following conclusions were drawn from the experiments: (1) Under certain conditions potato scab can be largely prevented in a practical way, but on badly infected ground no treatment was of any practical benefit. (2) Spraying the ground and seed gave better results in the non-infected soil than soaking the seed in the fungicide. In the infected soil there was practically no difference between the two methods. (3) In the test of fungicides used as a spray, all experiments being considered, the corrosive sublimate gave the best results. If only the non-infected soil be considered, then the greatest freedom from scab was secured by zinc sulphate, followed by corrosive sublimate and iron sulphate in the order named. When the seed was soaked in the fungicides for all experiments zinc sulphate gave the best results; for those experiments conducted in non-infected soil iron sulphate gave the best result, followed closely by corrosive sublimate, Bordeaux mixture, and zinc sulphate in the order named. The other fungicides had but little effect in decreasing the amount of scab. Copper sulphate decreased the yield and eau celeste killed all seed soaked in it.

The zinc and iron sulphate solutions were made by dissolving 1 ounce in 1 gallon of water. The Bordeaux mixture was made by the standard formula. The corrosive sublimate formula was 2 ounces to 2 gallons of hot water; let stand over night and then dilute to 15 gallons. Each of these cost less than 1 cent per gallon. They should all be kept in wooden vessels on account of their corrosive power.

Preventive measures are recommended as follows: (1) Select soil free from scab fungus if possible; (2) plant clean, smooth seed; (3) scabby potatoes or beets should be thoroughly cooked before being fed to stock in order to prevent the fungus from being disseminated with manure; (4) treat all seeds either by spraying or soaking in the fungicide; (5) if the presence of scab is suspected, dig the potatoes as soon as they mature, for the scabs will deepen as long as the tubers remain in the ground.

Bordeaux mixture used to prevent potato blight, C. E. HUNN (*New York State Sta. Bul. No. 49, n. ser., Jan., 1893, pp. 13–16*).—This is a report upon the experiments mentioned in Bulletin No. 41 and the Annual Report of the station for 1891 (E. S. R., vol. IV, pp. 55 and 250). Half strength Bordeaux mixture is recommended for the first two sprayings and full strength for two subsequent applications. This treatment cost $6.50 per acre, and the increased yield over non-treated potatoes was 40 bushels per acre. If 3 to 5 pounds of hard soap be added to the formula, or 5 pounds of molasses, the solution will adhere better to the foliage and less frequent sprayings will be needed. Adding Paris green or London purple will divide the expense of application and destroy the potato beetles.

Apple scab, W. M. MUNSON (*Maine Sta. Report for 1891, pp. 110–121, figs. 7*).—A brief popular account of *Fusicladium dendriticum*, together with notes and tabulated data for spraying experiments. Modified eau celeste and ammoniacal carbonate of copper (ammonia 1 quart, copper carbonate 3 ounces, water 30 gallons) materially reduced the amount of scab. Copper carbonate in suspension was not successfully used. Directions for preparing the fungicides and illustrated descriptions of spraying apparatus are also given.

Spraying apple orchards in a wet season, E. G. LODEMANN (*New York Cornell Sta. Bul. No. 48, Dec., 1892, pp. 265–274, figs. 4*).—An account of spraying for apple scab and apple worm during the past season upon trees mostly of the King and Baldwin varieties. The season was such as is supposed to favor the growth of both the fungus and the worm and make the application of fungicides a difficult matter. A meteorological table shows that during June, when the first two sprayings were given the trees, there were fifteen rainy days, with an excess rainfall for the month of 1.31 inches.

Bordeaux mixture and Paris green or London purple were used in combination, and Paris green was used alone. The formula for the Bordeaux mixture was: Sulphate of copper (crystals) 6 pounds, lime (unslaked) 4 pounds, water 40 gallons.

The arsenites were used at the rate of 2½ ounces to 40 gallons of liquid. The cost of applying 4½ gallons (the average amount required) of either of the combinations was about 7 cents per tree for each spraying. Spraying with Paris green alone cost about half as much. Four sprayings were given, and the author thinks this number sufficient for even very wet seasons.

Trees should be well pruned, so that all parts may be reached by the spray. Well-pruned trees allow free access of light and air, preventing the fungi from securing as strong a foothold. Pruned trees may be sprayed more economically than others. The first application was made June 13, about a week after the petals had fallen.

The author now thinks this application should have been made earlier, and that an application before the buds open would be valuable. The

other applications were made on June 22 and July 1 and 22, the same formula being used in every case.

The apples were harvested in October and carefully examined for scab and worms. Those gathered from two to four trees of each lot were counted and graded into four lots, as follows: (1) Free from scab and worms; (2) attacked slightly but marketable as first-class; (3) second class or evaporating apples, and (4) cider apples. By combining the third and fourth grades the following table is given for the different trees:

Results of spraying experiments on apple trees.

Variety.	Treatment.	Average of 3d and 4th grade.	Average gain over check.	Average of wormy.	Average gain.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
King	Check	89.7		25	
Do	Bordeaux and Paris green	55	34.7	1	24
Do	Bordeaux and London purple	59	30.7	3	22
Do	Paris green	72	17.7	2	23
Baldwin	Check	74		38	
Do	Bordeaux and Paris green	52	22	9	27
Do	Bordeaux and London purple	67	7	15	23
Do	Paris green	58	16	4	34

From the foregoing table the author concludes that—

(1) The injury done by the apple-scab fungus was decidedly reduced where the Bordeaux mixture was used.

(2) When Paris green was added to the Bordeaux mixture the fungicidal action of the combination was more marked than when London purple was used instead of Paris green.

(3) Paris green has a certain fungicidal value, but in this is not equal to Bordeaux mixture.

(4) The value of Paris green as an insecticide does not appear to be materially affected whether applied alone or in combination with Bordeaux mixture.

(5) The insecticidal value of Paris green when used with the Bordeaux mixture was greater than London purple when similarly applied.

(6) More applications are required during a wet season than during a dry one; during wet weather they should be repeated every week or ten days.

(7) The results obtained from the application of a combination of the Bordeaux mixture and Paris green or London purple show that the use of such a combination is valuable and practicable for the treatment of the apple-scab fungus and the apple worm, even in a very wet season.

Prevalence of apple scab, E. G. LODEMANN (*New York Cornell Sta. Bul. No. 48, Dec., 1892, pp. 275–291*).—A circular was sent out to horticulturists with inquiries regarding the prevalence of scab on different varieties of apples. Thirty-six replies on about 200 varieties are tabulated, from which the following conclusions are drawn: (1) It would appear that no part of the United States is free from scab; (2) it is probable that none of our commonly cultivated apples are free from scab in all seasons; (3) some varieties are much more subject to the disease than others.

From the tables given, it would seem that the Fameuse, Early Harvest, Red June, and Winesap are very liable to scab, while the Baldwin, Seek-No-Further, Astrachan, and Ben Davis are usually free from scab.

Root knots on fruit trees and vines, C. W. WOODWORTH (*California Sta. Bul. No. 99, Dec. 16, 1892, pp. 1–3*).—This disease attacks several plants, chiefly the grape and apricot, causing a weakened growth and often the death of the plant. The part usually attacked is the crown of the root, and for this reason the author proposes the name of "crown galls," to distinguish them from nematode and other root galls, from all of which they seem sufficiently distinct.

The crown galls arise generally from one side of the crown as a simple swelling of fleshy substance of about the consistency of a potato, or perhaps somewhat harder. They soon become irregularly granular over the surface and dark brown in color, the outer parts of the granulations into which the surface is divided being the darkest. When cut or broken open they are almost white at first, but very soon become reddish-brown on exposure to the air. Under the microscope they may be seen to be composed of large, thin-walled cells, with now and then the distorted and scattered elements of the fibro-vascular bundles.

A young gall of this kind contains very much water, and on drying becomes sponge-like in appearance and is very light and quite hard. Older knots are similar but harder, and dry into harder and firmer masses, which do not shrink or become sponge-like. * * *

The presence of a gall at the crown of a plant seems to effect an obstruction to the flow of the sap, and in this way a tree or vine becomes weakened and finally dies. The gall generally attacks small plants, but not always, and it often takes a number of years before the plant is killed. * * * In size the crown gall varies greatly, being often as large as one's fist and sometimes much larger, especially in the apricot.

Several theories have been advanced as to the cause of the disease, but the author finds objections to all of them. He finds the root knots are not always due to physiological reasons, such as healing of wounds or peculiar conditions of weather, nor has he discovered any of the well-known fungi present in the galls, or about them.

He has isolated and secured pure cultures of a species of *Micrococcus* from some of the knots, but it remains to be demonstrated whether this is the specific cause of the disease.

The usual precautions for the selection of nursery stock are urged. All infected stock from the nursery should be burned. If the disease appears in the orchard, remove and burn the knots as soon as found, and treat the wounds antiseptically. For this purpose Bordeaux mixture is recommended. All suspected trees or vines should be examined from time to time. If any die, remove and burn them, and do not attempt to reset for a year or two with any susceptible stock. This disease is to be the subject of further study.

The chemistry of Bordeaux mixtures, E. G. LODEMANN (*New York Cornell Sta. Bul. No. 48, Dec., 1892, pp. 291–296*).—An abstract of the results of experiments conducted by Livio Sostegni,* professor

*Le Stazioni sperimentali agrarie Italiane, August, 1890.

of chemistry in the Royal School of Viticulture and Viniculture at Avellino, Italy. The summary given in the bulletin is as follows:

(1) In preparation of Bordeaux mixture, 13.21 parts of slaked lime are equivalent to 10 parts of quicklime.

(2) More copper remains in solution when slaked lime is used than when the lime is fresh.

(3) The quantity of copper remaining in solution diminishes rapidly as the liquid is allowed to stand.

(4) The action of heat is favorable to the decomposition of copper compounds remaining in solution in the Bordeaux mixture.

(5) The copper is precipitated in the Bordeaux mixture in the form of hydrate, basic sulphate, and the double basic sulphate of copper and calcium.

(6) It is probable that the precipitated copper compounds are effected by the carbonic acid gas of the atmosphere. The solvent action is particularly strong where the copper is in the form of basic sulphate.

A new nozzle tester, C. W. WOODWORTH (*California Sta. Bul. No. 99, Dec. 16, 1892, p. 4*).—This apparatus is designed to test the relative merit of the various kinds of nozzles upon the market.

The most conspicuous part of the new nozzle tester is a large tank intended to maintain a constant pressure. From the lower part of this tank a large pipe leads to the apparatus, to which the nozzle is attached. The large diameter of this pipe makes the friction of the water flowing through it practically nothing. Just before the point where the nozzle is attached there is a steam gauge to register the pressure and a mercury manometer for determining more accurately the lower pressures. * * *

The data that will be determined for each nozzle under different pressures are as follows: (1) Volume of discharge per second, (2) velocity of stream just in front of the nozzle, (3) distance the spray is thrown, (4) angle of dispersion, (5) average fineness of spray, (6) distribution of spray, and (7) uniformity in fineness.

It is believed that by such a study of new nozzles the following questions may be settled: (1) The best type of nozzles for particular purposes, (2) the conditions under which each nozzle gives its best results, and (3) the changes in the construction of any nozzle which will make it more available for any particular purpose.

We also intend to study old nozzles, comparing them with new ones of the same kind, to determine—(1) the cause and amount of deterioration, (2) changes in construction which might overcome these defects.

The details of the apparatus and results of actual tests of the more common nozzles on the market will be given in a subsequent bulletin.

ENTOMOLOGY.

Grasshoppers, locusts, and crickets on cranberry bogs, J. B. SMITH (*New Jersey Stas. Bul. No. 90, Dec. 8, 1892, pp. 31, plates 2, figs. 18*).

Synopsis.—An account of observations made in view of the claim by many cranberry growers that grasshoppers and crickets are injurious to cranberries. The structure, food habits, and life history of grasshoppers, katydids, and crickets are described in detail, with illustrations. A list of thirty-five species of Orthoptera taken on cranberry bogs in New Jersey and on Cape Cod is given. The conclusion is reached that katydids, and not grasshoppers or crickets, cause the injury to berries on cranberry bogs. Reference is made to previous reports by the author on cranberry insects in Special Bulletin K, and the Annual Report of the station for 1891 (E. S. R., vol. II, p. 418; IV, p. 57).

The season of 1892 was very favorable to the growth of Orthoptera. A number of observations in different localities by the author and his assistant, R. S. Lull, are reported. The results of the observations at Jamesburg, New Jersey, are stated as follows:

The species [found on the bogs August 6] were *Melanoplus femur-rubrum*, *M. differentialis*, *Paroxya atlantica*, *P. recta*, *Stenobothrus maculipennis*, and *Acridium obscurum* among the Acrididæ, and *Scudderia furculata*, *Xiphidium brevipenne*, and *X. fasciatum* among the Locustidæ. An examination of the crop contents seemed to indicate that one specimen of *Paroxya recta* had been feeding on cranberry pulp, not seeds. In one specimen of *Stenobothrus maculipennis* some seed fragments were found, which might have been of cranberry, but might equally well have been of the grasses that were then producing seed in abundance. In all the other grasshoppers, grass tissue only was found. The katydid (*Scudderia*) crops were full of undoubted cranberry seed fragments, while in the two species of *Xiphidium* grass tissue only was found. * * *

[From the species collected at the same place August 29 there were placed in jars] specimens of *Melanoplus femur-rubrum*, *Paroxya recta*, *P. atlantica*, *Stenobothrus maculipennis*, *Dissosteira carolina*, *Xiphidium fasciatum*, *X. brevipenne*, and immature *Conocephalus* and *Gryllus neglectus*. The species of *Xiphidium* and the *Conocephalus* were placed together in one jar; each of the other species had a jar to themselves. In each jar was placed a handful of cranberries and a few blades of grass, the intention being to give the insects the best possible opportunity of attacking cranberries. No cranberries were attacked so long as an eatable spear of grass remained, and then one species only, *Paroxya recta*, touched the berries. Even here only a little of the outside pulp was eaten, and the seed capsule was not reached. The eating was utterly unlike that seen on the bogs, where the seeds only are taken and the pulp is rejected. More grass was added, and the cranberries were not again touched. In the jar containing the *Xiphidium* and *Conocephalus*, the consequences were more serious, for here I found the *Conocephalus* eating the specimens of *X. brevipenne*, and then, rather than touch cranberries, it died of starvation. More grass was added and the specimens of *X. fasciatum* survived some time, the last being killed and dissected September 14. The other species gradually died, as no fresh grass was added, all of them actually starving rather than to eat cranberries. The cricket ate neither grass nor cranberries, and died in a few days; the abnormal surroundings probably making it indisposed to feed. Concerning crickets, I know that they will get under cranberry crates in the fall and will eat berries; they will also eat into berries on the ground, but I do not believe that they will eat berries still on the vines.

My observations and experiments all go to confirm my previous statements. The Acrididæ or short-horned grasshoppers do very little if any of the injury to berries on the cranberry bogs, while of the Locustidæ or long-horned grasshoppers the katydids are the main culprits, aided occasionally by a species of *Orchelimum*. * * *

The injury on cranberry bogs attributed to grasshoppers is always the same. The berry is eaten into from one side, the pulp is rejected, and only the seeds are taken. The berry soon dries and shrivels up. The very fact that there is no variation in the injury points to the conclusion that only one or a few very closely allied species can be responsible for it, because it would be a decidedly unusual thing for insects of different families, differing also anatomically, to have so exactly the same food habits.

Much more common on the bogs and on low bushes and shrubs are the species of *Scudderia* or narrow-winged katydids. There are three species found in our State, the more common forms being *S. curvicauda* and *S. furculata*, and these are the species that injure the cranberries.

[The reasons why katydids rather than grasshoppers are injurious are summarized as follows:]

(1) Difference in the shape of the head. That of the katydid is especially well

adapted for digging into fruit with the least expenditure of time and energy, while the blunt head of the grasshopper, closely appressed to the prothorax, can not gain the same end without considerably more labor. The difference in the form of the mandibles again indicates the possibility of a kind of clean-cut work by the katydid, quite beyond the ability of the scoop-shaped structure in the grasshoppers.

(2) The differences in the digestive systems, indicating how much better adapted is that of the katydids for the reduction of a hard food, like seeds, while the grasshoppers from their structure would be more likely to choose a substance needing a less complicated grinding apparatus. The feeding and digestive abilities of the katydids are at least three times those of the largest grasshopper found on the bogs, while it would be at least tenfold that of the common red-legged grasshopper, which is the most abundant form there. * * * The habit of eating seeds only gives the katydid a power to cause injury vastly greater than if the entire fruit was eaten. The seeds of three or four berries at a meal is easily within the capacity of a single specimen. At even one meal a day for three weeks a single insect would destroy eighty berries at least, and I believe that their powers are much greater because in many cases only a part of the seeds are eaten, and the number of berries attacked is thereby much increased.

[The following treatment of cranberry bogs is advised:]

(1) A clean bog. This will not offer attractions to insects that might afterwards develop a fancy for berries. Absence of grasses and rushes will also make it impossible for the smaller locusts to find places for their eggs. Absence of shrubs will make it impossible for the katydids to oviposit on the bogs; for I do not think that they would lay their eggs in the small cranberry leaves. If they really did so I doubt whether many of them would survive winter flowing.

(2) Keep the bogs as wet as is consistent with good culture, and after picking bring the water well up to the top of the ditches and keep it so until the time for winter flowing. This will prevent egg-laying by grasshoppers and crickets, and will drive out the latter. Keeping the bogs quite wet in spring, until the soil is thoroughly warmed through, will destroy any eggs that may have been deposited in it. Grasshoppers will lay their eggs preferably in hard, sandy knolls or in decaying stumps; crickets, in loose, dry, sandy spots. Have none such on the bogs.

(3) Have the marginal ditch 6 feet wide at least on all sides of the bog, and keep it clean and at least partly filled with water. This will prevent the immature forms from coming on from the edges. No immature grasshopper or katydid will voluntarily try a jump across a sheet of water so wide. The insects are poor swimmers, but generally manage to make land when they accidentally get into a stream. I do not believe that they ever voluntarily attempt to swim from one point to another.

(4) Keep the dams as clear of vegetation as possible, and particularly keep all shrubbery from them. Early in spring they should be burnt over, so as to destroy all dead leaves, etc., that may have blown or drifted upon them. Where it is possible to do so, the brush around the bogs should be destroyed, and a fairly wide margin, to be burnt over every spring, should be kept free. This burning over would destroy the leaves containing katydid eggs, and lessen the number of insects.

By these means most of the Orthoptera except perhaps crickets, could be kept off the bogs until they are winged, and then I would recommend, when injury is noticed, a boy or man with a hand net to capture katydids. They are not very active, and, when started up, fly only a short distance. When located they can be readily captured, even without a net. * * * Twice a week would be often enough, if the collecting is carefully done. When fresh injury is noted special search for the culprits should be made in all cases.

Spraying experiments for the codling moth, 1891, W. M. MUNSON (*Maine Sta. Report for 1891, pp. 99–109*).—Notes and tabulated data are given for experiments in several localities of Maine in spraying apple trees with Paris green (1 pound to 250 or 300 gallons of water).

Spraying materially reduced the amount of wormy fruit. The stronger solution gave the best results, but even a single spraying with the weaker solution saved a large percentage of the fruit.

Point of attack.—The objection has been raised by some of our fruit-growers that a large proportion of the affected fruit is entered from side or base, and consequently that spraying before the fruit turns down has no special merit. Special attention was accordingly directed to this point. The variety under consideration was Rhode Island Greening.

Observations with reference to entrance of codling moth into apples.

No. of tree.	Whole number of wormy fruits.	Entrance at calyx.	Entrance at side or base.	Remarks.
1	57	24	33	Sprayed twice—1 pound to 250 gallons.
2	39	14	25	Do.
3	96	32	64	Sprayed twice—1 pound to 300 gallons.
4	154	63	91	Do.
5	238	141	97	Not sprayed.
6	211	111	100	Do.

It will be observed that while the absolute number of wormy fruits is greatly in excess in case of the unsprayed trees, the relative number of entrances at the calyx is more than doubled. The most plausible explanation for this condition would seem to be that the poison lodging in the calyx had destroyed the larvæ attempting to enter that end, while those entering the side or base escaped. The larvæ of the second brood were also exempt.

It was observed that a large proportion of the fruits infested had been attacked by the second brood and the larvæ were still present. To spray for this later brood is hardly practicable, but if the earlier brood is held in check there will be less trouble from the later.

In many cases the casual observer would attribute injury to the codling moth when in reality it is due to another insect—a species of *Crambus*. The larva of this moth is smaller than that of the codling moth and works only in the calyx. This insect was quite abundant the past season and rendered the work of examination for the codling larvæ more difficult.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Analyses of cattle foods (*Maine Sta. Report for 1892, pp. 26, 27*).—Analyses of linseed meal, feed flour, flour sweepings, and Pratt's Food are given as follows:

Analyses of cattle foods.

	Air-dry.						Water-free.				
	Moisture.	Ash.	Protein Nx6.25.	Fiber.	Nitrogen-free extract.	Fats.	Ash.	Protein Nx6.25.	Fi	Nitrogen-free extract.	Fats.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Linseed meal	9.03	5.60	39.94	7.28	35.27	2.88	6.15	43.94	8.00	38.77	3.15
Feed flour	7.32	2.82	20.81	1.93	62.44	4.68	3.04	22.44	2.08	67.38	5.05
Flour sweepings	11.33	2.50	10.62	1.89	72.03	1.63	2.82	11.98	2.13	81.23	1.84
Do	8.80	15.95	9.19	1.50	59.35	5.21	17.49	10.07	1.64	65.09	5.71
Pratt's Food	12.36	5.79	13.75	5.94	56.80	5.36	6.60	15.69	6.77	64.83	6.11

Pratt's Food was sold at $120 per ton, it being claimed that it possesses unusual medicinal and nutritive value. Examination showed it to be essentially ground bran or shorts with a small amount of fenugreek and about 3 per cent of salt. In the opinion of the author "its purchase at a price exceeding the ordinary cost of commercial cattle foods is a waste of money."

Production of food material by various fodder and root crops (*Maine Sta. Report for 1891, pp. 41–46*).—With a view to determining the amount of food material which might be produced per acre in Maine, Southern corn, flint corn, sweet corn, sugar beets, mangel-wurzels, ruta-bagas, English flat turnips, black-eyed marrowfat peas, and Hungarian grass were grown on similar areas of land, all manured in the same manner. The yields of these different crops, together with the calculated yield of digestible matter per acre, are tabulated. A summary of the average results for 1890 and 1891 follows:

Summary of average yields of fodder and root crop for 1890 and 1891.

	Yield per acre of crop as harvested.	Yield per acre of dry matter.	Yield per acre of digestible dry matter.
	Pounds.	*Pounds.*	*Pounds.*
Southern corn	39,615	5,580	3,850
Ruta-bagas	31,695	3,415	2,978
Hungarian grass	18,910	4,680	2,967
Sugar beets	17,645	2,590	2,447
English flat turnips	28,500	2,559	2,375
Field corn (flint)	21,690	3,110	2,208
Sweet corn	18,260	2,671	1,870
Mangel-wurzels	15,375	1,613	1,266
Peas (seed)	1,665	1,415	1,231
Timothy hay (assumed crop)	4,000	3,590	2,065

No attempt was made to produce the maximum crop; the object was merely to test the relative growth of these crops under conditions as nearly similar as it is possible to make them. The results are given as a report of progress in an investigation to be continued. The question of cost was left out of account.

(1) The large variety of fodder corn, namely, the Southern White Horse Tooth, under the conditions in which the crops were grown, greatly excelled the other varieties of corn and the roots in the production of total and of digestible dry matter.

(2) The crops which rank next in the production of digestible dry matter are Hungarian grass and ruta-bagas.

Special attention is called to the very favorable comparative showing of Hungarian grass as a fodder-producing crop.

(3) The common impression seems to be that our varieties of field corn and sweet corn which mature in this latitude and which are harvested for the silo after the plants have reached maturity or nearly so, contain much less water and more dry matter than the larger varieties of Southern corn. While these experiments show a difference in the percentage of dry matter in favor of the field corn and sweet corn, the difference has not proved to be as great as many would expect. The average results for three years show that the Northern field corn contained only 2 pounds of dry matter per hundred more than the Southern corn at the time the crops were harvested.

(4) These experiments illustrate very fully the already familiar fact that the weight of a green fodder crop is not a correct standard for judging its value. For instance, 18,940 pounds of Hungarian grass contained more than a third more dry matter than 31,695 pounds of ruta-baga turnips, and practically as much dry matter as 32,000 pounds of Southern corn.

Influence of food upon the quality of butter (*Maine Sta. Report for 1891, pp. 62–69*).

Synopsis.—Five cows were fed in three different periods rations composed of barley and peas or corn meal and wheat bran, with cotton-seed meal or linseed meal. The melting point of the butter was lower in the case of four cows and the percentage of olein less in the case of all of the cows on barley and peas than on cotton-seed meal, corn meal, and wheat bran. The volatile acids were apparently not affected by the food.

In the study of this question five cows of the station herd, including one Holstein, two Ayrshires, and two Jerseys, were fed during three periods, receiving cotton-seed meal, corn meal, and wheat bran during the first period; pea meal and barley meal during the second period; and linseed meal, corn meal, and wheat bran during the third period. The amounts of corn meal and wheat bran fed in the first and third periods were the same and the amounts of cotton-seed meal and linseed meal were also the same. From 3 to 4 pounds each of peas and barley were fed per head. On five days in each period the milk was analyzed, the cream raised in cold deep setting, and churned. The butter was tested for melting point, volatile fatty acids, and iodine equivalent, and the results of these tests, together with the yield and composition of the milk, are tabulated for each cow. The composition of the feeding stuffs is also given. These data show that the milk yield diminished somewhat in passing from the first to the second period, and increased slowly in the third period, but that in composition it varied but little.

With four of the cows the melting point of the butter was considerably lower during the second period than during the first. The relative amount of volatile acids varied only within quite narrow limits and apparently was not affected by the food. With all the cows the percentage of olein (liquid fat) was apparently considerably less during the second period, when the peas and barley were fed, than during the first and third periods.

Even though it is possible to draw only limited conclusions from this experiment, some practical suggestions appear:

(1) Quite radical changes may be made in the kind of grain ration fed without affecting the quality of the milk.

(2) The tendency of butter to melt during hot weather may be influenced by the kind of food, and also the degree of hardness may be affected.

(3) A mixture of cotton-seed meal or linseed meal with corn meal and wheat bran, especially the cotton-seed meal mixture, produced butter less easily melted and of a more solid appearance than did the peas and barley.

The author reviews similar investigations elsewhere.

Digestion experiments (*Maine Sta. Report for 1891, pp. 29–40*).—The results are reported of experiments with sheep on the digestibility of Hungarian grass, Hungarian hay, corn fodder from Southern corn, corn fodder from ordinary field corn, corn fodder from sweet corn, tim-

othy hay, sugar beets, mangel-wurzels, ruta-bagas, English flat turnips, gluten meal, and wheat bran. All these materials, except the gluten meal and wheat bran, were grown on the station farm in the summer of 1890.

Each trial was with two or four sheep and lasted twelve days, the feces being collected the last five days. The data given include the composition of the various materials and the calculated coefficients of digestibility. The average coefficients found are as follows:

Summary of digestion coefficients.

	Dry substance.	Organic matter.	Ash.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.
	Per ct.	*Per ct.*	*Per ct*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct*
Hungarian grass	63.4	65.6	35.5	62.4	52.3	67.8	65.8
Hungarian hay	65.0	66.3	47.4	60 0	63.8	67.6	67.1
Southern corn fodder	69.4	70.6	57.4	65.4	70.9	74.2	69.5
Field corn fodder	70.6	72.4	52.9	61.8	70.2	75.6	72.6
Sweet corn fodder	69.7	73.5	39.4	61.8	76.4	76.7	72.1
Timothy hay	58.5	60.1	29.6	44.1	74.3	56.4	63.6
Timothy hay	59.1	60.2	39.7	47.5	69.8	54.8	64.7
Sugar beets	94.5	98.7	31.9	91.3	49.9	100.7	99.9
Mangel-wurzels	78.5	84.8	16.4	74.7	....	42.8	91.3
Ruta-bagas	87.2	91.1	31.2	80.3	84.2	74.2	94.7
English flat turnips	92.8	96.1	58.6	89.7	97.5	103.0	96.5
Gluten meal	87.4	89.1	....	86.6	87.8	....	90 8
Wheat bran	59.8	64.0	....	82.1	64.0	36.2	64.1

(1) The Hungarian grass, both when fed green and after drying, proved to be more digestible than the average of other grasses, notably more so than timothy.

(2) The drying of the Hungarian grass into hay did not diminish its digestibility. This is in accordance with all former experience.

(3) The corn plant as cut for the silo is one of the most digestible of fodder plants, rating in these experiments as compared with timothy as 120:100. Sixty per cent of the dry organic matter of timothy was digested, while with the various corn fodders the average was 72 per cent. The experiments of this year disclose no special differences in the digestibility of the Southern, field, and sweet corn fodders.

(4) The digestion trials with roots show them to be the most digestible of any of the foods tested, the amount of waste material being very small, averaging not over 8 per cent of the whole.

(5) The gluten meal, which is a waste product in the manufacture of glucose from corn, was digested to the extent of 89 per cent of its dry organic matter, which does not differ at all from the figures given in the German tables for the entire grain. The treatment which the grain receives in converting the starch into glucose does not seem to affect the digestibility of the refuse.

(6) The second trial of the digestibility of American wheat bran gives average figures almost similar to those obtained in the first trial, and shows this cattle food to be but slightly if any more digestible than good hay, and much inferior in this respect to grains, such as maize, oats, barley, etc.

Turnips as food for sheep (*Maine Sta. Report for 1891, pp. 47–52*).

Synopsis.—A comparison on two lots of twelve sheep each of turnips and a quantity of grain furnishing a like amount of dry digestible matter, resulted favorably to the grain.

To test the feeding value of turnips for sheep, two lots of twelve sheep each were fed during two periods, the first lasting from December 23

to January 30, and the second from January 30 to March 3. Thirty pounds of ruta-bagas were compared in the first period with 5 pounds and in the second period with 4 pounds of a grain mixture composed of three parts of gluten meal, two parts of corn meal, and one part of wheat bran, by weight. The grain ration fed in the first period contained about 0.4 of a pound more digestible matter, and both grain rations contained considerably more digestible protein than the turnip ration. In both periods, hay, grain, and ruta-bagas were fed to each lot. In the second period the lots were reversed, the lot on ruta-bagas being changed to the grain ration and *vice versa.* In the first period the lot on the grain ration gained 97 pounds and the lot on ruta-bagas 72 pounds in weight. In the second period, when 30 pounds of ruta-bagas were compared with 4 pounds of grain, the lot on grain gained 138 pounds and the lot on ruta-bagas 124 pounds, still showing an advantage for the grain as compared with the roots, although the latter contained rather more digestible material.

During the 63 days covered by the experiment one half of the sheep ate 1,340 pounds of digestible material and the other half 1,338 pounds. The total gain in weight on roots was 196 pounds and on grain 235 pounds, a difference of 39 pounds in favor of the grain.

"This test furnishes a weighty bit of evidence against the somewhat common opinion that the dry matter of roots has an especial and peculiar value beyond the small quantity which it may be wise to feed for the purpose of giving variety to the ration." The advantage of the grain is attributed to the excess of protein.

An experiment in producing growth in lambs (*Maine Sta. Report for 1891, pp. 53–57*).

Synopsis.—In a comparison of grain *vs.* no grain for young lambs, the lot on grain gained in three months 453 pounds, while the lot on no grain gained 238 pounds in weight. The lot fed grain was valued at $32.66 more than the lot fed no grain, and the cost of the grain eaten by this lot was $12.79.

To compare the economy of feeding lambs full and scanty rations, two lots of 10 ewes and 12 lambs each were fed for three months as follows: The sheep of lot 1 received 1 pound of grain each per day, with hay *ad libitum*, and the lambs had access at all times to a supply of mixed grain; the sheep of lot 2 received ½ pound of grain per head, daily, and the lambs received no grain except what they ate from the mothers' ration. The grain mixture consisted for a part of the time of three parts of gluten meal, two parts of corn meal, and one part of wheat bran, and for the remainder of the time of equal parts, by weight, of linseed meal, corn meal, and wheat bran.

The tabulated results show that the lambs in lot 1 on the liberal ration gained 423 pounds, and those in lot 2 on the moderate ration 238 pounds in weight. The ewes in each lot lost between 100 and 200 pounds in weight during the time the lambs were with them, after deducting the weight of the fleeces, those in lot 2 losing 52 pounds more than lot 1.

The extra amount of grain eaten by lot 1 amounted to 984 pounds, which, at $26 a ton, cost $12.79. The lambs in lot 1 were considered worth more than those in lot 2, for they were ready for the market, while the others were not. They were therefore valued at 10 cents, and those in lot 2 at 6 cents per pound live weight. The calculation on this basis shows the lambs in lot 1 to be worth $25.36 more than those in lot 2, which, after deducting the cost of the extra grain, leaves a net gain of $22.47 from the liberal feeding.

Feeding silage to lambs, I. P. ROBERTS and G. C. WATSON (*New York Cornell Sta. Bul. No. 47, Dec., 1892, pp. 247–249*).

Synopsis.—In a comparison of silage with mixed hay for lambs 4 pounds of silage took the place of about 1 pound of hay and proved cheaper at current prices than hay.

Two lots of five grade Shropshire lambs about eight months old were fed from December 8 to April 27 to compare silage with mixed hay, mostly clover. Lot 1 was given silage, hay, and a grain ration composed of one part of linseed meal, two parts of cotton-seed meal, and four parts of wheat bran, by weight; and lot 2 was given hay with the same grain ration as lot 1. The five lambs on silage made a total gain of 135½ pounds and those on dry food 124 pounds. The total amount of dry matter consumed in the food by the two lots was practically the same. The lot on dry food drank 555 pounds more water than the one on silage, but considering the water in the food the silage lot consumed 324 pounds more water than the lot fed wholly on dry food. The 1,166 pounds of silage eaten took the place of 300 pounds of hay and proved the cheaper food in this experiment.

To carry the comparison still further, assuming as a basis a yield of 2 tons of hay per acre, would require as an equivalent a yield of less than 8 tons of silage per acre. As a matter of fact our land that produces 2 tons of hay yields from 12 to 16 tons of silage per acre. Or the comparison may be made in still another way: If hay costs $10 per ton the silage in this experiment had a feeding value of more than $2.50 per ton.

Nitrogenous and carbonaceous rations for lambs, I. P. ROBERTS and G. C. WATSON (*New York Cornell Sta. Bul. No. 47, Dec., 1892, pp. 250–253*).

Synopsis.—A comparison of a nitrogenous ration with a carbonaceous ration for lambs resulted as follows: The lot on the nitrogenous ration (1: 3.5) consumed about 27 per cent more dry matter, drank about twice as much water, and gained about 21 per cent more in weight than the lot on the carbonaceous ration (1 : 8.4).

From November 15 to February 26 two lots of nine grade Shropshire lambs about eight months old were fed, one on a carbonaceous ration having a nutritive ratio of 1 : 8.4 and the other on a nitrogenous ration having a nutritive ratio of 1 : 3.5. Both lots received hay and turnips for coarse food and lot 1 (carbonaceous) received a grain ration of seven parts of corn and one part of oats, while lot 2 (nitrogenous) received a mixture of three parts linseed meal and two parts of wheat

bran, and a mixture of three parts cotton-seed meal and two parts wheat bran in the evening. The amount of grain fed was regulated by the appetite of the animal. The tabulated results show that lot 1 on the carbonaceous ration gained 202 pounds, and lot 2 on the nitrogenous ration gained 245½ pounds during the trial; and that lot 2 consumed about 35 per cent more hay and about 17 per cent more grain and drank more than twice as much water as lot 1. The lot on the nitrogenous ration consumed about 27 per cent more dry matter and gained about 21 per cent more in weight, and the gain was much more uniform than in the case of lot 1. It is a matter of experience at the station that in comparisons of nitrogenous and carbonaceous rations the gain of the individuals on the nitrogenous ration is more uniform than on the carbonaceous ration.

Nitrogenous and carbonaceous rations for pigs, I. P. ROBERTS and G. C. WATSON (*New York Cornell Sta. Bul. No. 17, Dec., 1892, pp. 253–261, figs. 3*).

Synopsis.—In two comparisons of nitrogenous and carbonaceous rations for pigs the results were not uniform. In the first experiment there was no marked difference between the gain in live weight and the chemical composition of the meat in the case of the two lots. In the second experiment the gain in live weight was larger and the proportion of lean meat was greater in the case of the lot fed the nitrogenous ration.

In the first experiment four Poland-China pigs, weighing about 120 pounds each, were divided into two lots and fed from December 23 to April 27, one hundred and twenty-five days. Lot 1 received corn meal and skim milk, furnishing a nutritive ratio of 1:8.9 (carbonaceous), and lot 2 received corn meal, skim milk, and meat scrap, furnishing a nutritive ratio of 1:2.8 (nitrogenous). Both lots made a rapid and uniform gain in live weight, averaging 1.22 pounds per head daily for lot 1 and 1.27 pounds for lot 2, and were nearly alike in total weight and general appearance. Reproductions from photographs of cross sections between the eleventh and twelfth ribs show no marked difference in the amount and distribution of lean and fat meat in the case of the two lots, and analyses which are tabulated of a section taken from the carcass of each hog between the eleventh and thirteenth ribs failed to show wider differences in protein between the two lots than between individuals of the same lot. In this experiment therefore the wide difference in the nature of the food did not materially affect the gain in live weight nor the proportion of fat and lean meat. The only marked difference in the internal organs was that the livers of the nitrogeneous lot were nearly twice as heavy as those of the carbonaceous lot.

In the second trial four Poland-China pigs about three months old were divided into two lots and fed from November 2 to April 12 carbonaceous and nitrogenous rations respectively. The pigs were offspring of the pigs fed in the previous trial, those in lot 1 (carbonaceous) being from a pig which was fed on the carbonaceous ration, and

those in lot 2 (nitrogenous), from one fed the nitrogenous rations as described above. In this experiment the carbonaceous ration consisted of twenty-seven parts of corn meal, two parts of beef tallow, and one part of meat scrap, the meat scrap being added to make the ration more palatable and the beef tallow to offset the meat scrap; and the nitrogenous ration, of two parts of corn meal and one part of meat scrap and skim milk. The nutritive ratios were 1:9 and 1:2.2, respectively. The average daily gain per pig was 1.1 pounds for the carbonaceous lot and 1.4 pounds for the nitrogenous lot. The pigs on the nitrogenous food were larger and longer, and showed less tendency to lay on fat. The proportion of lean meat was considerably larger in the case of this lot. The amount of fat meat was larger in the lot fed the carbonaceous rations and the amount of lean meat much less than in the pigs fed on the nitrogenous ration.

In this experiment the addition of the small amount of meat scrap and scrap tallow to the ration of lot 1 seemed to have the desired effect of increasing the consumption of grain of that lot, for on one or two occasions when the animals of this lot were fed their usual amount of corn meal without the meat scrap and scrap tallow the meal was not all consumed, but when the same quantity of corn meal was fed with the meat scrap and scrap tallow the food was greedily consumed.

Conformation of horse, governing selection, E. A. A. GRANGE (*Michigan Sta. Bul. No. 89, Dec., 1892, pp. 9*).—This article contains tentative scales of points with reference to conformation, education, health, and history of the horse. Separate conformation scales are given for the coach stallion and mare, draft stallion and mare, thoroughbred stallion and mare, and the trotting bred stallion. The bulletin is so arranged that readers interested in this subject may note their views regarding the proposed scales and return the marked copies to the author, who hopes thus to be able to formulate a scale of points which will be of value in judging of the merits of different classes of horses.

Feeding experiments with colts (*Maine Sta. Report for 1891, pp. 58–61*).

Synopsis.—In a comparison on two grade Percheron colts eleven months old, of oats, with a grain mixture of middlings, gluten meal, and linseed meal, considerably larger gains were made on the grain mixture, which was the more nitrogenous ration.

A comparison recorded in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 391) of oats with a mixture of peas and middlings, resulted very favorably to the latter grain, and the present experiment was made to compare oats with other common commercial feeding stuffs of a nitrogenous character.

Two grade Percheron colts eleven months old, a filly and a gelding, were fed in two periods of forty-three and forty-one days each. In the first period 10 pounds of hay and 516 pounds of grain mixture composed of middlings, gluten meal, and linseed meal, and in the second period 10 pounds of hay and 617 pounds of oats were fed per head. The average cost of the daily ration in the first period was 12 cents and in the second

period 14 cents. The average daily gain in weight during the first period (grain mixture) was 1.51 and 1.16 pounds respectively, and in the second period (oats), 0.43 and 0.93 pound.

"In two tests of the relative growth produced in colts by mixed grain and by oats, the greater growth was obtained in both instances from the mixed grain. [The conclusion is that] oats are a comparatively costly feeding stuff, and if they are not essential to the horse ration there would be a financial advantage in discarding their use, so long as present prices hold."

DAIRYING.

E. W. ALLEN, *Editor.*

The Babcock milk test adapted to testing cream, J. M. BARTLETT (*Maine Sta. Report for 1891, pp. 71–80, fig. 1*).—A reprint of Bulletin No. 3 (second series) of the station (E. S. R., vol. III, p. 397) with a few further remarks in explanation of the method of applying the test at creameries.

Experiments in the manufacture of cheese, July–October, 1892, L. L. VAN SLYKE (*New York State Sta. Buls. Nos. 46 and 47, n. ser., Sept. and Nov., 1892, pp. 185–242, 243–306*).—Accounts of experiments in cheese-making in May and June have been reported in Bulletins Nos. 43 and 45 of the station (E. S. R., vol. IV, pp. 365, 426). The experiments in July, August, September, and October, described in the present bulletins, form a part of the same series of investigations which is being carried on at the station and at cheese factories in the State. The experiments of each month are published separately, with a summary of the results. These accounts present full tabulated data for the experiments, including analyses of the milk, whey, and cheese; the loss of milk constituents, etc. The principal results for the four months are here summarized.

Loss of milk constituents in cheese-making.—The actual amount of fat lost in the whey per 100 pounds of milk was fairly uniform under the same conditions of manufacture and was practically independent of the amount of fat in the milk. The average amount of fat lost in the whey in the different months ranged from about 4½ to a little over 5 ounces for 100 pounds of milk, which was from 7.5 to 9.4 per cent of the fat in the milk. As a rule the loss was slightly less in the station experiments than in the factory experiments. The amount of casein and albumen lost in the whey was quite uniform under all the conditions tried. The average amount of casein and albumen lost in the whey was about 12 ounces for 100 pounds of milk, equivalent to from 22½ to 24 per cent of the casein and albumen in the milk.

Influence of composition of milk on composition of cheese.—In the cheese made from normal milk, the amount of fat in 100 pounds of green cheese

varied from about 32 to 37¼ pounds. In the cheese made from milk one fourth skimmed, the fat was diminished to from 28.75 to 31.68 pounds. Skimming a little less than one-half reduced the fat to 23.13 pounds, and skimming one-tenth, to 31.5 pounds. The addition of cream to milk increased the fat in the cheese to 38.13 pounds. In general, the fat exercised a greater influence upon the composition of the cheese than did any other constituent of the milk. In the cheese made from the normal milk the amount of casein and albumen in 100 pounds of cheese was a fairly uniform quantity, varying in the green cheese from 22.3 to 25.5 pounds. Skimming the milk increased and adding cream diminished the per cent of casein and albumen in the cheese.

The results appear to indicate that in cheese made from normal milk containing from 3.5 to 4.4 per cent of fat there should be from 1.3 to 1.5 pounds of fat for 1 pound of casein and albumen in the water-free cheese. Partial skimming reduced this ratio considerably.

Influence of composition of milk on yield of cheese.—Of the increased yield of cheese obtained in the various experiments, from 40 to 93 per cent was due to an increase of fat in the milk from which the cheese was made. The amount of fat retained in the cheese made from 100 pounds of milk increased when the amount of fat in the milk increased, but not with exact uniformity. The amount of casein and albumen retained in the cheese made from 100 pounds of milk increased quite uniformly when the amount of casein and albumen in the milk increased. The amount of water retained in the cheese made from 100 pounds of milk was quite variable and appeared to be dependent upon conditions of manufacture more than upon the composition of the milk. The proportion of the increased yield due to increased amount of water retained in the cheese ranged from 5 to 50 per cent in various experiments. The amount of milk required to make 1 pound of cheese varied between 8.45 and 10.04 pounds.

Influence of variation of conditions of manufacture.—The use of a large amount of rennet was accompanied by a little larger loss of fat in some cases and a smaller loss in other cases. The yield was slightly greater with the larger amount of rennet, owing to retention of water.

As between the losses of fat in cutting the curd in hard and soft condition, the results were conflicting. Hard cutting usually gave a larger yield, owing largely to retention of more moisture.

As between the stirred-curd and the Cheddar processes, the results were not uniform.

When the curd was cut coarse there was a smaller loss of milk constituents and a decidedly larger yield of cheese, but the cheese was very salvy owing to the excess of water retained. When tainted milk was used the loss of fat was increased from 0.3 to 0.5 pound for 100 pounds of milk, the yield of cheese was diminished, and the flavor and texture were unfavorably affected.

Milk was aërated by passing it through a Baby separator and then

mixing the cream and skim milk. The loss of fat in manufacture was a little greater with such milk than with the unseparated milk, while there was in addition considerable loss from inability to mix fat completely with the skim milk. The yield was somewhat less from the separated milk. Under the conditions employed, the losses were not increased by exposing milk to foul odors, but the experiments are regarded as preliminary and not conclusive for general conditions. The yield was not affected. When milk was diluted with water the loss was slightly above the average, but the yield of cheese was not apparently diminished.

Loss of cheese in weight.—The loss in weight the first month after manufacture varied from 4.6 to 9.34 pounds for each 100 pounds of green cheese, excepting the cheese made from partially soured milk, which lost 15.7 pounds.

Cheese and its manufacture, N. E. WILSON (*Nevada Sta. Bul. No. 18, Nov., 1892, pp. 27, figs. 17*).—This bulletin, as its subject indicates, is devoted to a popular discussion of the subject of cheese-making in general, the processes of cheese manufacture, cheese-making apparatus, the method of running a cheese factory, paying for milk, etc.; a review of the San Francisco cheese market for four years past; the outfit for a cheese factory, both in connection with and separate from a creamery; and a plan of arrangement of a combined creamery and cheese factory.

"Dairying is no longer an experiment in this State. The industry is firmly established. Nevada butter is unsurpassed in quality and there is no reason why we cannot make an equally good quality of cheese."

The bulletin is illustrated with cuts of various kinds of cheese vats, curd knives, curd mill, curd sink, cheese presses, and cheese hoops.

STATION STATISTICS.

Reports of director and treasurer of Maine Station (*Maine Sta. Report for 1891, pp.* I-VIII).—Brief general statements regarding the work of the station and a financial report for the year ending June 30, 1891. Attention is called to the fact that Maine is the only State in which the inspection of fertilizers is paid for out of funds appropriated by the United States Government, and it is recommended that the State provide for this work. The horticultural department was organized during the year and additional facilities were provided for dairying and pig-feeding.

Equipment of Maine Station (*Maine Sta. Report for 1891, pp. 21–28, plates 5*).—An illustrated description is given of the station barn and feeding stalls, and of the equipment for making digestion experiments and other feeding experiments with cows, sheep, pigs, etc.

Report of the statistician (*Division of Statistics, Report No. 100, n. ser., Nov. and Dec., 1892, pp. 379–416*).—This includes the following articles: Agricultural production and distribution of the world; tests of averages of condition; address of the statistician at the annual meeting of the Patrons of Husbandry; reciprocity and agricultural exports; European crop report for December, 1892; notes on foreign agriculture; and freight rates of transportation companies.

The crops of the year (*Division of Statistics, Report, Dec., 1892, pp. 28*).—Notes and tabulated data regarding the meteorological conditions affecting crops in the United States in 1892; the general history of the crops of the year and the estimated yields of corn, wheat, oats, and flaxseed; farm prices; and notes from reports of State agents.

The following table gives the average crops of corn, wheat, and oats during different periods, as compared with the crops of these cereals in 1892:

Yield, area, and value of corn, wheat, and oats in the United States.

	Total yield.	Total area.	Total value.	Average value per bushel.	Average yield per acre.	Average value per acre.
CORN.	*Bushels.*	*Acres.*	*Dollars.*	*Cents.*	*Bushels.*	*Dollars.*
Average, 1870–'79	1,184,486,954	43,741,331	504,571,048	42.6	27.1	11.54
Average, 1880–'89	1,703,443,054	70,543,457	668,942,370	39.3	24.1	9.48
1892	1,628,464,000	70,626,658	642,146,630	39.4	23.1	9.09
WHEAT.						
Average, 1870–'79	312,152,728	25,187,414	327,407,258	104.9	12.4	13.00
Average, 1880–'89	449,695,359	37,279,162	371,809,504	82.7	12.1	9.97
1892	515,949,000	38,554,430	322,111,881	62.4	13.4	8.35
OATS.						
Average, 1870–'79	314,441,178	11,076,822	111,075,223	35.3	28.4	10.03
Average, 1880–'89	584,395,839	21,996,376	180,866,412	30.9	26.6	8.22
1892	661,035,000	27,063,835	209,253,611	31.7	24.4	7.73

The meteorological records of the season, as compiled from original data gathered by the Weather Bureau, show that during the crop season of 1892, covering the period of crop growth from April to September, inclusive, there was an excess of rainfall in the principal agricultural districts, accompanied by low temperature dur-

ing the early season up to July, and a temperature above the normal during the closing months. The rainfall of the season, although heavy, was not well distributed, the excess of the year having occurred in the early months accompanied by low temperatures, leaving the hot months of August and September with a marked deficiency. * * * The record of crop history of the year will serve to strikingly illustrate the intimate relation between meteorology and crop production. As already pointed out. the early season was unusually wet and cold, conditions which tended to seriously hinder the preparation of the soil, planting, and germination of seed. This is reflected in decreased areas of some crops and substitution of others, as well as in the comparatively low returns of condition which were made during the first few months of the growing season. The change in conditions during the latter part of July and in August and September, giving warm, dry weather, is likewise manifest in the crop record. There was improvement in the returns of condition, a more hopeful feeling becoming apparent as the season progressed, and harvesting and threshing results exceeded expectations as a result of unusually favorable weather conditions at that important season. * * *

There has been a heavy increase in barley in the past two years. The crop of 1891 was the largest ever harvested. Another increase was made last year generally, though there was a slight decrease in New York. The production of barley has increased in ten years nearly 50 per cent, and the volume of importation has decreased materially.

Buckwheat remains the smallest cereal crop, with slight tendency to enlargement. The usual product is about 12,000,000 bushels, of which New York and Pennsylvania produced six-tenths, and Michigan, Wisconsin, and Minnesota about half of the remainder. Very little is grown in the South. * * *

One of the poorest crops of potatoes ever reported was garnered in 1892. It was a little better than those of 1881 and 1887. The October report of condition made an average percentage of 67.7, or two-thirds of a normal crop. Planting was interfered with in the central West by heavy rains, and there was some complaint of rotting of the seed on account of the moisture of the seed bed. The potato beetle was present as usual, but was not a large factor in deterioration compared with the heavy rainfall. A further decline was reported in August, which was heaviest in New England and the Middle States. Blight and rot began to threaten the crop. Alternations of wet and dry weather affected it in the East, and in the Ohio Valley and Northwest it was injured by excess of moisture, while in Iowa damage was done by heavy rains in the early season followed by continued hot weather, which packed the soil and prevented cultivation and growth. The injury in Kansas and Nebraska was mainly the result of drouth in the later season. The crop was in fairly good condition in the mountain States, and only moderately so on the Pacific coast. Its quality, as a whole, is quite inferior. * * *

The cotton acreage was heavily reduced, from the discouraging effect of low prices, in accordance with the recommendation of this Department and all intelligent friends of cotton-growing. In the Mississippi region a compulsory reduction resulted from overflows of that river and its tributaries. * * *

The general average of condition in October was five points lower than in 1891, and the lowest of any season since 1884. The crop will be the smallest for several years, first on account of diminution of area, and in a less degree from low condition.

It has been a poor year for the orchard fruits of the temperate zone, except that apples have been abundant in some portions of New England. * * *

In 1891, as a result of high prices of flaxseed and especially favorable conditions for seeding, the crop reached the largest proportions ever recorded. There almost seemed indications of a genuine and permanent revival of interest in flax-growing, judging by the sudden increase in the area devoted to the crop in most districts where it is grown. Based as it was, however, on a merely temporary market advance, it was foreseen that it could not be permanent. * * *

That this view was correct was proven by the returns for the present year. The falling off in acreage and production from last year is very heavy and quite generally distributed. Naturally, however, it is less marked in the newer agricultural districts, where flax is essentially a pioneer crop, grown both for its value as a money crop and as a means of subduing the rich virgin soil. The westward movement of the center of production, the result of the tendency to make flax a first crop in the development of agriculture, which has been made apparent at each successive census or special investigation, is continued. In 1880 about 65 per cent of the crop was grown east of the Mississippi River. By the present return it appears that only a little more than 1 per cent now comes from this district. * * *

[Flax is principally grown in Minnesota, Iowa, Kansas, Nebraska, and South Dakota.]

The crop is now grown practically for seed, the straw and fiber not being utilized under present conditions, and so long as this prevails the crop can not become a general or comparatively important one in American agriculture.

Proceedings of the ninth annual convention of the Association of Official Agricultural Chemists, H. W. WILEY (*Division of Chemistry, Bul. No. 35, pp. 260*).—This is a detailed report of the convention held in Washington, August 25-27, 1892. A brief account of this meeting has already been given (E. S. R., vol. IV, p. 115).

Contributions from the U. S. National Herbarium (*Division of Botany, Contributions from the U. S. National Herbarium, vol.* I, *No. 6, Dec. 6, 1892, pp. 189-232, plates 2*).—This includes a list of plants collected by C. S. Sheldon and M. A. Carleton in the Indian Territory and adjacent regions during 1891, and some observations upon the native plants of the same regions.

The list of plants, with numerous critical notes, is by J. M. Holzinger. Two new species, *Ipomœa carletoni* and *Euphorbia strictior*, are described and figured.

The observations upon the native plants are by M. A. Carleton. He considers them under the following heads: Plants characteristic to Oklahoma and eastern Indian Territory, western Indian Territory, southern Kansas, Neutral Strip, and the Panhandle of Texas. He also considers them in reference to their places of growth as plants characteristic of sandy regions, of the gypsum hills, of the salt marshes, and of the sandstone outcrops.

The diurnal variation of barometric pressure, F. N. COLE (*Weather Bureau Bul. No. 6, pp. 32*).—Atmospheric pressure undergoes regular daily variations, attaining as a rule two maxima and two minima every twenty-four hours. The minima occur between 2 and 4 in the morning and afternoon, and the maxima between 8 and 11 in the forenoon and evening.

On the open sea, in the tropics, where the disturbing effect of a land surface is eliminated and the daily variation in temperature reduced to a minimum, the barometric curve is almost perfectly symmetrical, presenting nearly equal maxima and minima at equal intervals of six hours. On land, however, and particularly in the interior of continents, the symmetry is considerably diminished, the maxima and minima are no longer equal, the day variation exceeds that of the night, and the intervals between the maxima and minima differ measurably.

The physical causes of this phenomenon have not heretofore been satisfactorily explained, despite its regular character. In the present article "the method of harmonic analysis, *i. e.*, the resolution of the barometric oscillation into its harmonic constituents," is applied to the solution of the problem.

It is found that the barometric oscillation consists in the main of two components, with periods of twenty-four and twelve hours, respectively. Of these the daily component is decidedly irregular in both phase and amplitude, and is undoubtedly due, at least in a large part, to local conditions. It nearly disappears on the tropical ocean, but occurs everywhere on the land with a large amplitude, which increases toward the centers of the continents and attains its maximum values in mountain valleys. The second (bidaily) component, on the contrary, presents the utmost regularity in both phase and amplitude.

It is apparently entirely independent of local conditions taking place over the entire earth, at least as far as latitude 60°, with a nearly mathematically uniform phase, and a constant amplitude, diminishing slowly as the latitude increases. Besides these two components there are others of higher orders, which however constitute only a very small part (in the mean perhaps one eighth) of the whole. Of course, the third component (period eight hours) seems from its regular character to represent a physical reality. Whether this is true of the others remains to be established. * * *

The first component is certainly due to such daily causes as the variation in the temperature with its single maximum, land and sea breezes, precipitation, frost, dew, and the general daily phenomena which are connected with the topography of the particular region.

The second component is an entirely different matter. We have here an oscillation with a period of twelve hours nearly uniform over the entire globe as far as latitude 60°, with a phase which moves with the greatest regularity forward in summer and backward in winter, through a range of about an hour. It is in form a perfect analogy to the solar tide. * * *

The only criteria available for distinguishing the real from the imaginary components are the regularity of the former and their coincidence with other physical phenomena. From this standpoint the third component must certainly be regarded as real. This component resembles greatly the second. Although very small in the mean, it is extremely regular and uniform over the whole earth. Its amplitude has a minimum at each equinox, a large maximum in winter and a smaller one in summer. Besides this the third component reverses it phase at the equinoxes, *i. e.*, its maxima in summer fall at the hours of the minima in winter. It seems certain that this component is connected in some way with the annual march of the sun, and is of the same general character as the second in regard to its moving cause.

The fourth component also shows a very noticeable regularity in both amplitude and phase, although much less so than the third. This component has a nearly constant amplitude from the vernal to the autumnal equinox, increasing about threefold in winter. The rapid and considerable change of its phase from month to month, while proceeding with great uniformity over the earth, makes it difficult to determine in many cases whether the change is a progression or a regression, and the difficulty is increased by the smallness of the amplitude in summer, which may decidedly affect the accuracy of the calculation of the phase. A satisfactory treatment of the fourth component would require its determination for smaller intervals than a month. Probably fifteen days would be a convenient interval. From the data available it would seem that the fourth component is, like the preceding ones, a physical reality.

The amplitudes and the phases of the first four components of atmospheric pressure computed* from the monthly means for periods of from 2 to 4 years for six cities, Boston, New York, Philadelphia, Chicago, St. Louis, and Denver, are given in tables and compared with similar data for Greenwich, England, for 20 years (1854–'73), besides tables showing the actual distribution of the barometric pressure for every 0.05 inch for every month from April, 1888, to December, 1891, at New York, together with the probable distribution deduced from the probability curve $y = \frac{h}{\sqrt{\pi}} e - h^2x^2$.

A compilation of analyses of American feeding stuffs, E. H. JENKINS and A. L. WINTON (*Office of Experiment Stations, Experiment Sta. Bul. No. 11, pp. 155*).—This includes all analyses of American feeding stuffs which were published before September, 1890, and were accessible to the compilers. The analyses are collated from the publications of this Department, of forty-nine experiment stations, and of schools, colleges, and agricultural societies in the United States and Canada. The earliest were analyses of corn, made in 1869 in the chemical laboratory of the Sheffield Scientific School, under the direction of Prof. S. W. Johnson. The total number of specimens of which analyses are given is 3,267. The analyses are classified as follows: Green fodder—cereal grasses, other grasses, and legumes; silage; hay and dry coarse fodders; roots, bulbs, tubers, and other vegetables; fruits; grains and other seeds; mill products; by-products and waste materials. Tables of maximum, minimum, and average composition are also given, together with a complete index.

* Using the formula $P_1 \cos. (x-\mu_1) + P_2 \cos. (2x-2\mu_2) + P_3 \cos. (3x-3\mu_3) + \ldots$

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

On the determination of nitrogen by the Kjeldahl method, O. BÖTTCHER (*Landw. Vers. Stat., 41, pp. 170–174*).—The author adopts the suggestion of Prof. Stutzer to change the name of this much modified method to that of "sulphate method" as distinguished from the soda-lime method. He recommends the Jodlbauer modification for the determination of nitrogen in nitrates, and Wilfarth's modification (addition of metallic oxides during digestion) for materials which are difficult to decompose, as ground horn, ground fish, etc. He finds, however, that the addition of mercury gives a higher result in some cases than copper, and prefers to add about 1½ grams of zinc dust instead of potassium sulphide and zinc dust in the distillation with sodium hydrate. The zinc dust alone, he states, suffices to free the ammonia from the mercuro-ammonium compounds.—E. W. A.

Method for determining nitrogen in nitrates, O. BÖTTCHER (*Landw. Vers. Stat. 41, pp. 165–169*).—The principle of the method proposed is far from new. It depends upon changing the nitrogen of the nitrate to ammonia by treating the salt in an alkaline solution with nascent hydrogen. The method is as follows: Ten grams of the nitrate is dissolved in 500 c.c. of water, and of this solution 25 c.c. (equivalent to 0.5 gram) is placed in the distilling flask of a Kjeldahl apparatus with about 120 c.c. of water, 5 grams of washed and dried zinc dust, 5 grams of iron powder, and 80 c.c. of sodium hydrate of 32° B; 20 c.c. of titrated sulphuric acid is placed in the receiving flask. After standing for one or two hours, with frequent shaking, about 100 c.c. of the solution is distilled over, and the result titrated as usual. In distilling, the flame is turned down very low at first to prevent the alkali from going over.

The author reports results which indicate the method to be reliable not only for pure sodium nitrate, but also for mixed fertilizers containing nitrates. On account of its simplicity, rapidity, and cheapness it is recommended where large numbers of determinations of nitrogen in nitrates are to be made.—E. W. A.

An easy practical method of determining nitrogen in nitrates, C. ARNOLD and K. WEDEMEYER (*Zeitsch. analyt. Chem., 31 (1892), pp. 389–392*).—After experimenting, with unsatisfactory results, with the Boyer (*Compt. rend., 113, p. 503*), Ruffle, and Tanner-Guyard methods,

the authors finally adopted the following: In a combustion tube 45 cm. long and 10–12 mm. in diameter, a 5-cm. layer of a mixture of nine parts of soda-lime and one of sodium formate is put; then a layer 25–28 cm. deep of a mixture of equal parts of sodium formate, soda-lime, and crystallized sodium thiosulphate with two parts of water-free sodium thiosulphate, containing the substance to be examined; and finally, 10 cm. of the soda-lime and formate mixture. The substances are used in coarse powder. The combustion is carried out as usual in the Ruffle method, this operation requiring from 25 to 30 minutes. The ammonia is collected in one-fourth normal hydrochloric acid and titrated with one-fourth normal ammonia solution, using fluoresceïn or lacmoid as indicator. The method gave practically theoretical results with strychnine nitrate and the metallic nitrates, but is not applicable to the determination of nitrogen in nitro-compounds, nitrites, and the nitrates of pyridin and quinolin.—W. H. B.

The reliability of the determination of phosphoric acid as magnesium pyrophosphate, especially by the molybdic method, H. NEUBAUER (*Zeitsch. anorgan. Chem., 2 (1892), p. 45*).—Experiments by the author lead to the conclusion that on strongly igniting the ammonio-magnesium phosphate a part of the phosphoric acid is volatilized. In the presence of a large amount of ammonium salts not all the phosphoric acid is precipitated as $MgNH_4PO_4$, but a part separates out as $Mg(NH_4)_4(PO_4)_2$. On igniting the latter the following reaction takes place: $Mg(NH_4)_4(PO_4)_2 = Mg(PO_3)_2 + 4NH_3 + 2H_2O$. By further ignition the metaphosphate passes into pyrophosphate, with loss of phosphoric anhydride, thus: $2\ Mg(PO_3)_2 = Mg_2P_2O_7 + P_2O_5$. The larger the amount of ammonium compounds in solution the greater the proportion of $Mg(NH_4)_4(PO_4)_2$ precipitated and the greater the loss of phosphoric acid.—W. H. B.

Preliminary note on estimation of total solids in milk, H. D. RICHMOND (*Analyst, December, 1892, pp. 225–227*).—In view of the decomposition believed to take place in drying milk in an open dish, the author proposes to dry on asbestos in a platinum dish, using about 3 grams of freshly ignited asbestos and 5 grams of milk. The milk is dried on a water bath for about two hours and then placed in a drying oven (water or air) at about 98° C. for about twelve hours (usually over night). A constant weight is thus obtained, which is not changed by drying longer, or at 105°. The results are about 0.1 per cent higher than by the method of the Society of Public Analysts.—E. W. A.

Action of some enzymes on milk sugar, H. D. RICHMOND (*Analyst, December 1892, pp. 222–225*).—The author finds that rennet, pepsin, and pancreas extract are without action on milk sugar, indicating that the milk sugar in whey and in artificially digested milk can be accurately estimated, provided they have not been heated.—E. W. A.

A criticism on the analytical methods of the Association of Official Agricultural Chemists, T. BREYER and H. SCHWEITZER (*Chem.*

Ztg. 1892, pp. 1720–1723).—Under the title, "False but official methods of commercial analysis in the United States," the authors question the accuracy of the Lindo-Gladding method for potash determination, at present recommended by the Association of Official Agricultural Chemists. First of all they quote the results published in the proceedings of the seventh convention (1890) of analyses by twelve chemists of samples of fertilizers. In a large number of comparisons by themselves of this method and the Fresenius method, the results were sometimes higher, but usually lower by the Lindo-Gladding method. Examination of the potassio-platinic chloride precipitate obtained with this method showed the presence of sulphuric acid, lime, magnesia, and ammonia. As the results were low in spite of these impurities, the authors concluded that there was a loss of potash in the operation, and tests of the alcohol washings showed potash. In one case a sample of sylvinit contained 15.45 per cent of potassium oxide by the Fresenius method and only 14.85 per cent by the Lindo-Gladding method. The platinum precipitate by the former (Fresenius) was free from sulphuric acid, lime, magnesia, and ammonia. The ammonium chloride and alcohol washings in the Lindo-Gladding method contained potash equivalent to 1.46 per cent of potassium oxide for 0.5 gram of substance.

Analysis of the platinum precipitate showed ammonia equivalent to 0.0176 gram of ammonio-platinic chloride, or in weight equivalent to 0.0034 grams of K_2PtCl_6, or 0.68 per cent K_2O for 0.5 gram of substance. Sulphuric acid and magnesia were also recognized qualitatively in the potassio-platinic chloride precipitate.

The difference in results by the two methods may be shown as follows:

	Per cent.
Lindo-Gladding method:	
K_2O in K_2PtCl_6 precipitate	14.85
K_2O in washings	1.46
	16.31
Ammonia in precipitate equal to K_2O	0.68
	15.63
Fresenius method:	
K_2O in K_2PtCl_6 precipitate	15.45
	0.18

The difference of 0.18 per cent between the two methods is attributed to sulphuric acid and magnesia, which were recognized qualitatively in the platinum precipitate. Numerous experiments like the above were made and always with similar results. In all cases the platinum precipitate was found to contain ammonia, and in many cases sulphuric acid, lime, and magnesia. The authors draw the following conclusions from their investigations:

(1) The use of sodium chloride in potash determinations is unscientific and an obstacle to the accuracy of the method, as the large amount of washing which it necessitates usually dissolves out some of

the potash precipitate. In one case it was found necessary to wash with 420 c. c. of alcohol before the precipitate became colorless.

(2) It is doubtful whether, with the large amount of washing required, the Lindo-Gladding method is any more simple than the Fresenius method.

(3) In washing with the prescribed half saturated ammonium chloride solution, a partial decomposition takes place, potassium chloride being washed out and ammonio-platinic chloride formed which remains on the filter.

(4) The inpurities in the $K_2 Pt Cl_6$ precipitate are not completely removed, especially when the substance analyzed contains magnesium and calcium sulphates.

(5) The American official method for potash determination is therefore wholly unreliable. The results obtained with it are sometimes too high and sometimes too low, according as the potash salt analyzed contains more or less impurities.

It is, therefore, of the greatestest importance to the German trade, and to chemists who desire to secure satisfactory results that this method be speedily abandoned.—E. W. A.

Determination of potash by the Lindo-Gladding method, A. F. HOLLEMAN (*Chem. Ztg., 1892, pp. 1926, 1921*).—The above criticism of Breyer and Schweitzer is reviewed and the percentages of potash in kainit, as determined by the Lindo-Gladding and the Fresenius methods, are reported as follows:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
Fresenius method	11.11	14.32	11.25	12.79	13.85	12.70	12.45	12.28
Lindo-Gladding method	11.05	14.42	11.44	12.99	14.09	12.80	12.55	12.33

The amounts of alcohol and ammonium chloride used for washing Nos. 7 and 8 were noted. Of the alcohol, 46 and 50 c. c., respectively, were used in the first washing, and 25 and 23 c. c. in the second; of the ammonium chloride solution. 25 c. c. in each case. The potassio-platinic chloride precipitate did not contain a trace of ammonia; a microscopic examination showed it to be pure, and only a trace of sulphuric acid was found. The possibility of magnesia or lime being present was therefore excluded.

In explanation of the unsatisfactory results secured by Breyer and Schweitzer, the author believes that in spite of the large quantity of alcohol used for washing the soluble platinum salts were not all removed, and consequently in the washing with ammonium-chloride solution ammonio-platinic chloride was formed, which remained on the filter as an impurity. To this is attributed the presence of ammonia in the platinum precipitate and not to a partial replacement of the potash of the platinum salt by ammonia in washing, as Breyer and Schweitzer assume.

The conclusion is that (1) the Lindo-Gladding method when properly carried out gives good results; (2) there is no good reason for abandoning the method; and (3) the Breyer and Schweitzer experiments were not fitted to prove the method unreliable.—E. W. A.

Deficiency of chlorophyll due to a low spring temperature, J. RITZEMA BOS (*Zeitsch. Pflanzenkrank., May, 1892, pp. 130–142.*—The author's attention was called on May 2 to specimens of winter rape, the leaves of which were discolored or blotched with yellow and white. At first the cause was thought to be the larvæ of *Psylloides chrysocephala*, and afterwards to be of fungous origin, but neither insect nor fungus was discovered. A microscopical examination of the leaf showed that the green portion was normal. In the discolored areas the cellular structure was normal, but the chlorophyll grains in the mesophyll were of a yellowish color. In the white spots there was a total absence of chlorophyll, a reduced amount of cell sap, and the protoplasm contained but few granules. On examination it appeared that there was a gradual transformation or disintegration of the chlorophyll granules in the various discolored portions of the leaf. From the fact that the weather had been unusually cold during the preceding month, the author was led to investigate the effect of different temperatures on this plant, thinking that thereby he might discover the cause of the abnormal appearance of the leaves. The author had observed that in some instances the cotyledons of *Phaseolus multiflorus* remained colorless even after the wide expansion of the first leaves. This he thinks was due to the cold, and he cites other examples of similar observations mentioned by Sorauer and Frank.

It is known that a plant can live and grow at a temperature below that at which it can form chlorophyll. The minimum temperature at which *Brassica napus* can grow is given by Sachs as 5° C. and the minimum at which chlorophyll is produced at 6° C. The average maximum temperature for the latter part of April (13–30) was about 7.5° C., with several days below 6°. There were during the month two hundred and seventy-five hours with a temperature of 5° or over, and but one hundred and seventy-five hours with a temperature of 6° or over, the temperature of the remaining time being below 5° C. The place in which the plants grew had a still lower average temperature. The author believes that in this low temperature the plant was growing faster than it could produce chlorophyll, and that this sufficiently accounts for the yellow and white blotches on the leaves. An examination made in the latter part of May, when the temperature was considerably higher, failed to disclose any discolored plants in the place from which the former specimens had been secured.—W. H. E.

On the reversion of water-soluble phosphate of lime in soil, M. STAHL-SCHRÖDER (*Journ. Landw., 40 (1892), No. 3, pp. 213–221).*—Experiments were undertaken to determine the rapidity with which superphosphate in concentrated solution reverts to the dibasic and tri-

basic forms when mixed with calcium carbonate or with soils poor in lime.

The materials used were superphosphate containing soluble phosphoric acid 21.32 per cent, reverted phosphoric 0.53 per cent, and total phosphoric acid 22.10 per cent; finely powdered chalk containing 93.30 per cent calcium carbonate; clay soil free from organic matter, sifted through a 1 mm. sieve, and containing 0.22 per cent of calcium carbonate; and sandy field soil poor in humus, containing 0.84 per cent of calcium carbonate.

In the first experiment 5 grams of superphosphate was mixed with 5 grams of chalk, in porcelain dishes, and made into a thick paste with water. After standing the desired number of hours the contents of the dishes were washed into 250 c. c. flasks, which were filled to the mark, shaken, and allowed to stand two hours. Fifty cubic centimeters of the solution was then filtered off and soluble phosphoric acid determined. For the determination of citrate-soluble phosphoric acid the contents of a second series of dishes were washed into flasks with 100 c. c. of ammonium citrate solution and the reverted phosphoric acid determined in the usual way.

The results obtained were as follows:

Reversion of superphosphate in presence of carbonate of lime.

	Per cent of total phosphoric acid.		
	Soluble.	*Reverted.*	*Insoluble.*
At beginning	96.5	2.4	1.1
After twenty-four hours	4.0	67.3	28.7
After three days	0.0	3.3	96.7
After twenty days	0.0	0.0	100.0

An extremely rapid reversion of the superphosphate is evident from the above figures.

In the second and third experiments 2 grams of superphosphate were mixed with 8 grams of clay soil and field soil, respectively, practically the same method of procedure being followed as in the first case. The results were as follows:

Reversion of superphosphate in clay and field soil.

	Per cent of total phosphoric acid.					
	Soluble.		Reverted.		Insoluble.	
	Clay.	Field soil.	Clay.	Field soil.	Clay.	Field soil.
At beginning	96.5	96.5	2.4	2.4	1.1	1.1
After twenty-four hours	87.4	63.2	10.1	3.6	2.5	33.2
After ten days	47.7	40.7	8.7	7.4	43.6	51.9
After twenty days	42.9	38.4	1.6	5.5	55.5	56.1

We see here a much less rapid reversion of the phosphoric acid, since at the end of twenty days only a little over half of the phosphoric acid had become insoluble.

These results indicate that with liberal applications of superphosphate on sandy soils poor in lime a part of the phosphoric acid may be lost in the drainage. The loss on clay soils is likely to be smaller on account of the resistance of such soils to leaching.

The author therefore recommends for sandy soils precipitated phosphate of lime, Thomas slag, or phosphorite meal. Composting of the latter with peat and sulphate of potash would be particularly advantageous, since the vegetable acids of the peat in connection with potash salts would gradually render the insoluble phosphoric acid available, and the vegetable matter incorporated in the soil by the use of such a compost would improve its water-holding capacity.—W. H. B.

Studies on the preparation of manure, A. HÉBERT (*Ann. Agron., 18 (1892), No. 11, pp. 536–550*).—These investigations were carried out with an artificial manure, in which the conditions were made to correspond as closely as possible to those which are known to prevail in natural manure. At the same time the leading factors in the fermentation of the material were kept well under control. Known quantities of fine-ground straw were placed in flasks and moistened with alkaline solutions of known strengths. The mixture was inoculated by adding a small quantity of liquid from natural manure, and the flasks were kept at a constant temperature of 55° C. The proportions used were 50 grams of straw, 200 c. c. of carbonate of potash, 200 c. c. of carbonate of ammonia, and 10 c. c. of phosphate of ammonia. The strength of the solutions varied in different cases from 1 to 10 per cent.

Three factors affecting fermentation were especially studied: (1) The alkalinity of the solutions; (2) the access of air; (3) the predominance of one or the other of the alkaline carbonates. The change in composition of the material and the transformation and loss of nitrogen during fermentation were determined.

The conclusions reached were as follows:

(1) If the solution with which the straw is moistened is distinctly alkaline formenic (or marsh-gas) fermentation takes place; if it is not, acid, hydric fermentation occurs.

(2) It appeared to make little difference whether the two carbonates were present in equal or unequal amounts.

(3) Free access of air did not appear to sensibly affect the fermentation.

(4) On fermentation, straw first loses all or a part of its more readily decomposable constituents—fats, gums, tannin, glucose, and dextrin; next, the higher carbohydrates, cellulose and straw gum, to a large extent, disappear; and finally, after combustion is more or less advanced, the vasculose dissolves in the alkaline liquid.

(5) In these experiments a part of the ammoniacal nitrogen passed into the state of organic nitrogen and a part of the total nitrogen disappeared in the free state.

(6) In the gas from the interior of a well-moistened heap of natural manure not the smallest quantity of ammonia was observed.

(7) Moistening manure regularly has the effect not only of preventing the loss of ammonia but also of promoting formenic fermentation.—W. H. B.

Experiments with winter wheat, T. SHAW and C. A. ZAVITZ (*Ontario College Sta. Bul. No. 79, Aug. 22, 1892, pp. 11*).—Notes and tabulated data for 44 Canadian and American varieties of winter wheat tested at the station in 1892. Twenty-four foreign varieties were also grown, but as none of them proved equal to some of the best of the American varieties, no details regarding them are given. The average yields per acre of the Canadian and American varieties in 1892 were, straw 3.2 tons and grain 42.6 bushels, weighing 60.5 pounds per bushel. The varieties which yielded more than 50 bushels per acre were Dawson Golden Chaff, Golden Drop, Mediterranean, and Fulcaster.

The varieties which have yielded an average of over 40 bushels per acre during the past three years are Surprise, Early Red Clawson, Rodgers, Red Velvet Chaff, Golden Drop, Bonnell or Landreth, Golden Cross or Volunteer, Manchester, Standard, Hybrid Mediterranean, and Martin Amber. During the past three years the average yields of the white varieties have been about 1 bushel per acre more than those of the red varieties, but the latter have averaged from 1 to 2 pounds more in weight per bushel.—A. C. T.

Experiments with spring grain, T. SHAW and C. A. ZAVITZ (*Ontario College Sta. Bul. No. 84, Dec. 15, 1892, pp. 8.*)—This article contains a summarized report on tests of 37 varieties of barley, 22 of spring wheat, and 81 of oats, which have been grown at the station during four years, and of 20 varieties of peas grown for two years. The varieties which have given the highest average results are as follows: Oats—Joanette Black, Chenailles Black, Black Etampes, and Siberian (white); wheat—Herison Bearded, Pringle Champion, Saxonka, and Holben Improved; barley—Mansbury, French Chevalier, Empress, and Scotch Improved; peas—Prussian Blue, Black-Eyed Marrowfat, and Princess Royal. The fifteen imported varieties of barley have given a larger yield during four years than the six rowed variety commonly grown in Ontario. In experiments in seeding oats, wheat, barley, and peas at different dates in 1891 and 1892, the best results were obtained as follows: Wheat April 22, oats and barley May 1, and peas May 9.—A. C. T.

Experiments on the influence of intermittent temperature, and the character of the seed bed on the germination of sugar-beet seed, GUSTAV PAMMER (*Oesterr.-ungar. Zeitsch. Zuckerind. u. Landw., 1892, Heft 4, pp. 15.*)—A series of 16 experiments was conducted with sugar-beet seed to determine the following questions: (1) Is a constant temperature of about 20° C. better than an intermittent temperature? (2) Is sand or paper the best seed bed in which to make germi-

nation tests of beet seed? (3) How often and upon what days shall the germinating seed be counted? (4) How long shall germinating tests last? (5) How many days shall be considered the limit for the germination of the seed?

The seed was carefully selected so far as to be of about constant quality and number for each duplicate experiment. One lot was grown in moist sand on shallow trays, and the other between the folds of filter paper. The moisture was kept constant. Every precaution was taken against error and the result is given for each test.

The conclusions based upon the experiments are stated by the author as follows:

(1) An intermittent temperature of about 28° C. for eight hours and about 18° C. for sixteen hours increases considerably the rapidity of germination as well as the per cent. (2) Sand is considered the best for germinating beet seed; paper is not recommended. (3) Six days should intervene between the first counting out and the separating of the sprouted and the unsprouted seed. The seeds which have not germinated should be left in the germinating apparatus. (4) Five days are sufficient for determining the vitality of sugar-beet seed. (5) On the twelfth day of the experiment, after the results have been established by counting the unsprouted seed and the germinated plants, the germination tests may be considered as ended.—W. H. E.

Weeds and modes of destroying them, T. SHAW and C. A. ZAVITZ (*Ontario College Sta. Bul. No. 85, Dec. 22, 1892, pp. 31, figs. 11*).—General directions are given for destroying noxious weeds, together with illustrated descriptions of eleven of the "worst" weeds of the Province of Ontario and specific directions for their destruction. They are Canada thistle, sow thistle, couch grass, oxeye daisy, burdock, blue weed, wild mustard, wild flax, pigeon weed, ragweed, and wild oats. The bulletin also contains the text of the act of the legislative assembly of the Province of Ontario to prevent the spread of noxious weeds and diseases affecting fruit trees.—W. H. E.

The discovery of the perithecia of Uncinula spiralis and the identity of the American and European Oidium, G. CONDERC (*Compt. rend., 116 (1893), pp. 210, 211*).—The author reports finding mature perithecia of *Erysiphe tuckeri* in a greenhouse in Ardèche, France, during last November. On further examination a few perithecia in various stages of development were found in several vineyards. Sufficient material was secured and examined to prove conclusively the identity of the perithecia, asci, and spores, with those of *Uncinula spiralis* of this country. The identity of the two had been claimed for some time, the evidence being based upon the similarity in mycelium, conidia, and conidiophores, the only parts then known in Europe.

In 1875 DeBary announced it as his belief that the Oidium of France was none other than the *Uncinula spiralis* of North America, which had been brought to Europe and through many changes had lost the power

of producing ascospores. This hypothesis was reaffirmed by P. Viala in 1887, his reason being the similarity of the diseases of the grape in Europe caused by *Erysiphe tuckeri* and in America by *Uncinula spiralis*. However, until the perithecia of both were known there were many who doubted their identity.

The author considers the presence of the perithecia in Europe in 1892 due to the peculiar conditions of temperature late last autumn, and thinks the climatic conditions nearly approached those usual in this country where the fruiting forms are constantly associated with the mycelium. The summer had been a very hot one. In October there were several days during which the minimum temperature was 0° or 2° and the maximum only 9° to 11° C. This was followed by a period of about thirty days of warm weather. It was during this period of unusual weather that the perithecia were developed in sheltered places. In addition to the interest which the systematic botanist will have in this discovery, it will also serve to remove the fear of the viticulturist of introducing a new American disease into his vineyard.—W. H. E.

A fungous disease affecting wheat and barley, W. CARRUTHERS (*Journ. Roy. Agr. Soc. of England, 3 (1892), ser. 3, p. 791*).—This disease appeared in August and spread rapidly through the fields. It affects the heads of grain, which have the appearance of being thinly dusted over with soot. The appearance of the crop is not satisfactory, but the actual injury done is not very serious, owing to the part of the plant liable to the attack of the fungus and to the fact that the mycelium usually does not penetrate very deeply into the tissues of the host. The dark brown fungus is called *Scolecotrichium graminis*, Fuckel. A partial description is here given.

"The densest masses of the fungus occurred between the tips of the inner glumes; they have also been found growing upon masses of pollen grains which still filled the cavity above the grain. It was also spread irregularly over the tips of the outer glumes, springing from the brown-jointed mycelium which was growing on the surface of the glumes as well as penetrating the epidermis and pushing its way through the glume. The fruiting stems burst through the epidermis in little tufts arranged in linear series. These stems are simple, jointed, and in the upper portion where the spores are borne, somewhat irregular. The spores are either terminal or lateral on the stem, are oblong, oval, and uniseptate. This fungus is supposed to be the conidial stage of *Sphaerella recutita*, Cooke."

Numerous unsuccessful attempts were made to get the spores to germinate with a view to studying the life history of the fungus. Its occurrence was reported from several widely separated localities.—W. H. E.

Reports upon experiments on the prevention and cure of potato disease, C. WHITEHEAD and J. A. VOELCKER (*Journ. Roy. Agr. Soc. of England, 3 (1892), ser. 3, pp. 761–783*).—Reports are made of two different series of experiments in the treatment of potato rot

(*Phytophthora infestans*) conducted during the season of 1892. The tests, six in number, were made at widely separated stations in England. The first series was a continuation of experiments during the previous year with Bordeaux mixture, made according to the following formula: Copper sulphate, 20 pounds; lime, 10 pounds: water, 100 gallons. The tests were made on early, medium, and late varieties, and the results were almost unanimous in favor of the use of the fungicide. The conclusions were as follows: (1) Bordeaux mixture lessened the amount of disease; (2) associated with the lessening of the disease was an increase of the yield; (3) early treatment was the best; (4) late applications, even after the appearance of the disease, prevented its spreading. The second series was conducted upon an experimental farm. Tests were made of soaking seed before planting in copper sulphate (2 per cent solution) and in a solution of ammonium sulphate 6 pounds, potassium sulphate 6 pounds, and water 25 gallons. In both experiments the seed was destroyed or its vitality greatly reduced.

In the experiments with spraying solutions two formulas for Bordeaux mixture were used, namely, copper sulphate 20 pounds, lime 20 pounds, water 100 gallons; and copper sulphate 20 pounds, lime 20 pounds, molasses 20 pounds, water 100 gallons. These formulas contain more lime than is used in this country. Tests were made on early, medium, and late varieties, part of each lot being also treated with early and late applications. The amount of the solution varied from 100 to 140 gallons per acre, and the cost of materials and application was from $2.04 to $2.36 per acre for the plain mixture, and $2.64 to $3.20 per acre for the Bordeaux mixture and molasses.

The season was a poor one for the growth of the fungus, none appearing on some of the check rows. Of the twelve varieties tested five showed profitable gains in yield from the treatment, four showed loss, and in three the gains or losses were about balanced. In five out of seven cases the disease was materially reduced by the use of the solutions, and in the others it was not increased. The conclusions were that Bordeaux mixtures reduced the amount of disease and increased the yield of crop; neither formula cured the disease after it was once present, but both were preventives. The addition of the molasses had no effect beyond increasing the expense of the fungicide.—W. H. E.

Potato culture and disease prevention (*Report of Wilts, England, Technical Education Committee, 1892, pp. 33, figs. 7*).—The subjects investigated were, (1) the value of selection of seed varieties and methods of planting, (2) manurial values, and (3) the value of the application of chemicals for prevention of disease.

All the experiments were under the control of a single competent individual. They were in three fields at considerable distance from each other. The fields contained 43, 17, and 20 square rods, respectively. Each field was divided into plats of 1 square rod. The prepara-

tion of the soil and the fertilizers used were the same on all the plats. Duplicate plats were treated for diseases, and great care was taken to avoid errors. Analyses of the soils showed that of the first field to be a sandy loam of fair fertility, of the second nearly pure sand, and of the third a stiff marl. The fertilizers used were soot, kiln dust, guano, "potato manure," and a complete chemical fertilizer. Analyses of all these fertilizers are given.

A meteorological table shows a total deficiency of 1.49 inches in rainfall from March until October, most of which was during the first four months. The character of the experiments is shown in the following statements regarding their results: Planting in rows 30 inches apart and 18 inches in the row is best for late varieties, but earlier ones may be planted closer; change of seed is desirable, but condition is equally important; sprouts should not be broken off before the seed is planted; early planting is best for late varieties.

Early varieties planted late are more subject to disease. Large seed is better than small, and repays the additional cost. Uncut seed is better than an equal weight of cut seed. The value of manure of different kinds depends upon the season. A heavy dressing of farmyard manure applied in the spring is barely remunerative on the first year's results. Chemical manures should contain nitrogen, potash, and phosphoric acid in proper proportions. Imperfectly compounded chemical fertilizers do not pay. Soot and kiln dust are barely remunerative in a dry season. Farmyard manures favor disease more than chemical fertilizers.

In experimenting for the prevention of disease two methods were employed, soaking the seed and spraying the plants. Seed was soaked for twenty-four hours in a solution made of 6 pounds each of sulphate of ammonia and nitrate of potash in 25 gallons of water. The tests showed that soaking seed in chemical solutions before planting is likely to be injurious, especially to some varieties. For spraying the plants two formulas of Bordeaux mixture were used, with and without molasses. In this series the indications were that some varieties are more subject to rot (*Phytophthora infestans*) than others. Potatoes should be dug as soon as ripe, as the disease may be communicated to them while in the ground.

Dressings of Bordeaux mixture, while not preventing disease, greatly reduced the amount of diseased tubers and increased the yield of sound ones. The applications paid for their cost many times over. In dry seasons the ordinary Bordeaux mixture is as effective as that to which the molasses has been added.

The copper solutions did not in any way affect the quality of the tubers. About 160 gallons of Bordeaux mixture was used each time and from one to three sprayings were given. In some places, though no disease appeared even on the untreated vines, the treated vines remained green and vigorous much longer than the others.—W. H. E.

Bees in relation to fruit, J. H. PANTON (*Ontario College Sta. Bul. No. 81, pp. 1*).—In April, 1892, the legislature of Ontario passed an act forbidding the spraying of fruit trees during the blooming period with "any mixture containing Paris green or any other poisonous substance injurious to bees." In view of the discussion among fruit-growers and bee-keepers as to the wisdom of this act, this bulletin gives information regarding the functions performed by bees in the pollination of fruits and their relation to the destruction of fruit. Evidence is cited to show that spraying trees in bloom with Paris green is likely to be very injurious to bees, and in some degree to the fruit as well.—A. C. T.

Composition and digestibility of feeding stuffs, TH. DIETRICH and J. KÖNIG (pp. 14, 15).—This lately published compendium is, for convenience in handling, bound in two volumes. Part I, which fills the first volume and a portion of the second, nearly 1,100 pages in all, is devoted to the chemical composition of feeding stuffs, and part II, some 325 pages, to their digestibility.

At the beginning of volume I, we find after the table of contents, which occupies 18 pages, tables of the composition of feeding stuffs, filling 896 pages. In these are given the results of analysis, with names of authors, and places of original publication, and such comments, including data as to origin, methods of culture, manuring, etc., and the characteristics of the materials themselves, as will give greatest value to the figures. Deficiencies in the statements in the original sources from which the data are taken, have, so far as practicable, been supplied. The authors have even gone to the extent of calculating the results to dry substance, where, as in the majority of cases, this was not done in the original, thus making the figures comparable.

The materials are classified as green fodder, dry fodder, roots and tubers, grains and seeds, by-products, etc. The subdivisions are such as to be at once convenient and useful. For instance, the chapter on meadow hay and aftermath includes twenty-eight tables. The first gives a general view of the composition of these materials; in the others distinctions are made between hay from natural meadows, hay from artificial meadows, hay from mountains and valleys, from woods, moors, and marshes, and hays produced under different conditions of soil, climate, and culture, and cut at different periods of growth. In like manner tables for the composition of milk, which fill more than one hundred and sixty pages, are arranged so as to distinguish not only between the milk of cows, goats, sheep, mares, asses, swine, and buffaloes, but also the variations with breed, age, individuality, period of lactation, feeding, care, and methods of milking, and the composition of cream and of skimmed milk as produced in various methods of dairy practice. While the material thus compiled was going through the press, a process which occupied several years, new data were accumulating which are put together in a supplement of over one hundred pages.

The analyses thus far referred to are those which have been made by methods now in common use, and can, therefore, be conveniently compared. But the authors have improved the opportunity to collate earlier analyses and at the same time to give a historical summary of analytical methods, from those used by Sir Humphrey Davy, the pioneer chemist, in this direction, to those now employed by the Association of German Experiment Stations. The tabular statements include the analyses of Davy in 1810, Horsford and Crocker in 1846, Anderson in 1853, and others. The historical development of this kind of inquiry is still further illustrated by quotation of the tabular compilations of analyses which have been published from time to time, commencing with those of Davy in 1810 and including those of Sprengel in 1830; Fresenius in 1847; Boussingault in 1850; Hennings in 1852; Emil Wolff's first table, which was published in his *Naturgesetzlichen Grundlagen des Ackerbaues* in 1856, and for comparison his table in the *Landwirthschaftliche Kalendar* for 1890. Lastly follow Julius Kühn's tables of composition and digestibility of feeding stuffs. The first part of the work closes with a discussion of the methods of estimating the money values of feeding stuffs, a subject to which the experiment stations, farmers, and dealers in Germany have given much attention.

The second part gives a no less exhaustive and admirable summary of the available information regarding the digestibility of feeding stuffs as based upon the results of experimental inquiry up to the present time. As the digestibility of feeding stuffs by different animals under varying conditions calls for more experimental research than the chemical composition there is more discussion in connection with the tables in which the experimental data are recapitulated. The tabular statements of results of experiments on the digestion of feeding stuffs by domestic animals give the composition of the materials fed and the coefficients of digestibility obtained, and are accompanied by citations of sources and such collateral data as are essential. A large number of tables in succeeding chapters, supplemented by clear and brief discussions, summarize the results of experimental inquiry regarding the effects of various factors upon digestion. Among these factors are the species, breed, and individuality of the animal, and the work done by it on the one hand, and on the other the amounts of fodder materials and their character as affected by condition (green or dry), the age or period of development of the plants, manner of curing, storage, and preparation for use, including cutting, steaming, etc. The results of experiments on the effects of concentrated feeding stuffs and of potatoes and roots upon the digestion of crude fodders are summarized. The available data are given regarding the effects of salt, alcohol, and aromatic substances upon digestion. The digestion of mineral substances is treated as a special topic. The methods and results of experiments on digestion by the artifical method are discussed with clearness and precision. To round out the treatment of the subject, the duration of the process of digestion by domestic

animals, the process itself, and the influence of metabolic products in the calculation of digestion coefficients are appropriately discussed. In this part of the work an appendix was also necessary for results published while the first manuscript was being printed.

The natural outcome of such a compilation is a final series of three tables in which the most reliable results are summarized. The first gives the coefficients of digestibility of nutrients, including maximum, minimum, and average figures, and distinguishing between results obtained with ruminants, with horses, and with swine.

The second gives maximum, minimum, and average percentage composition (including crude protein and actual albuminoids), and estimated percentages of digestible nutrients of a large number of feeding stuffs. Estimates of feeding and manurial values as based upon market prices in Germany are appended. This table fills 120 pages.

The third table, of 42 pages, is devoted to data regarding the nitrogenous ingredients of feeding stuffs. It gives averages for albuminoid nitrogen, non-albuminoid nitrogen, and nitrogen not digested by the artificial method. The quantities are expressed in percentages of dry substance and total nitrogen.

An illustration of the completeness of the work is found in the final table. The German experiment stations have been led to investigate the degree of rancidity of fats in feeding stuffs as an indication of either the freshness of the latter or the amount of decomposition and consequent deterioration in value which they have undergone. These investigations have mostly been undertaken within a short time past, but the results which were available when the last pages of the work were going through the press are recapitulated in a table at the end.

The second volume closes with an alphabetical index of 33 pages, which, with the table of contents at the beginning of each of the two volumes, makes a complete and easy means of reference to the topics in this immense but most orderly compilation of results of inquiry.—W. O. A.

Effect of increased or decreased consumption of food and of the addition of certain salts on the digestibility of the food nutrients, H. WEISKE (*Landw. Vers. Stat., 41, pp. 145–161*).—In previous experiments the author has shown that the effect of either acid sodium phosphate or sodium citrate added to oats fed alone to rabbits was to diminish both the amount of food consumed and the increase in live weight, and to affect the quantity and quality of the bones; and that a ration of oats alone was not adapted to young rabbits. When either calcium carbonate or hay was added to the oats, the rabbits developed normally; and when sodium phosphate was added to a ration of hay and oats no disadvantageous effects developed for a long time. The addition of calcium carbonate to oats was found to have little, if any effect on the proportion of nitrogenous material digested.*

* Landw. Jahrb., 21, p. 791; E. S. R., vol. IV, p. 437.

In continuing these experiments the effect was studied of additions of calcium phosphate, acid sodium phosphate, and sodium citrate on the digestibility of oats. The same oats were used as in the trial with calcium carbonate previously reported. The trials were with rabbits. The coefficients of digestibility found were as follows:

Digestibility of oats alone and combined with various salts.

	Organic matter.	Crude protein.	Crude fat.	Crude cellulose.	Nitrogen-free extract.	Crude ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Oats alone	82.3	92.6	93.1	34.6	85.6	59.0
Oats and calcium phosphate	78.9	90.2	88.0	23.4	84.2	45.6
Oats and acid sodium phosphate	80.2	86.6	89.8	56.2	90.1	55.1
Oats and sodium citrate (No. 1)	84.9	87.5	95.3	46.6	89.1	60.1
Oats and sodium citrate (No. 2)	81.8	88.0	95.0	37.8	85.9	54.7

Except in the case of protein, the effect of the salts on the digestibility seems to be independent of any general rule.

The coefficient for protein was invariably lower where salts were added, and especially so where sodium phosphate or citrate was added. To further study the effect of sodium citrate, five rabbits, all of the same litter, were fed no citrate, and later amounts of the citrate ranging from 0.1 to 0.75 gram per day. The results were not very conclusive, but the author believes the effects of the citrate were apparent. Individuality seemed to play an important part. The two rabbits receiving no citrate and 0.75 gram of citrate were killed after forty-nine days' feeding. The percentages of potash, soda, and lime in the blood ash were noticeably lower in the case of the rabbit receiving 0.75 gram of the citrate, which agrees with the observation of W. Beckmann, that the consumption of sodium citrate tends to withdraw the potash, soda, and lime from the body.

The coefficients found when oats were fed alone in these two trials and in the former trial* are compared in the following table:

Digestibility of oats when fed in varying amounts.

Amount of oats eaten.	Organic matter.	Crude protein.	Crude fat.	Crude cellulose.	Nitrogen-free extract.	Crude ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
93.5 grams	64.3	66.8	93.6	19.6	67.9	29.2
84.5 grams	77.0	81.3	94.7	10.4	84.2	50.2
52.0 grams	82.3	92.6	93.1	34.7	86.5	59.9

With the exception of crude fat and cellulose, the rate of digestibility is in inverse proportion to the amount of oats eaten. The differences are very noticeable, especially when it is considered that the oats were all from the same lot and that the only difference in food or treatment was in respect to the amount of oats eaten. Evidently the digestion

* Landw. Jahrb., 21, p. 796; E. S. R., vol. IV, p. 439.

was more thorough when the smaller ration was given. The result is considered quite remarkable, for although similar differences have been observed by the author and by E. von Wolff with sheep, the differences have always been very much smaller. Another interesting point is, that while the digestion coefficient for protein was about 20 per cent higher by the artificial than by the natural method when the larger amount of oats was fed, the reverse was true when the smaller amount was fed, although the difference between the two was less than before—92.6 per cent by the natural method and 88.43 per cent by the artificial method. Pepsin solution alone was used in the artificial digestion. In the opinion of the author these results all go to show that under ordinary conditions artificial digestion gives the maximum coefficient of digestibility, and that the results can only be expected to agree with those obtained in natural digestion when all the conditions of food, mastication, digestion, etc., are perfectly normal, and when the ability of the animal to resorb the nutrients is intense.—E. W. A.

Effect of rations of varying nutritive ratios on the secretion of milk, and the digestibility of chlorophyll and wax-like substances, R. KOCHS and RAMM (*Landw. Jahrb., 21, pp. 809–838*).—In this experiment three cows of as many different breeds were fed in four periods of about a month each, with intermediate periods. Rowen hay, wheat straw, and beets were fed throughout the trial, with brewers' grains and peanut cake in such proportions as to make the nutritive ratio 1:8.19 in the first, 1:5.42 in the second, 1:4.31 in the third, and 1:8.19 in the fourth period. The ration was the same for the first and last periods. All three rations contained practically the same amount of dry matter and very nearly equal amounts of digestible non-nitrogenous materials.

The cows were milked three times daily, and analyses made daily of the mixed milk of each cow. The cows were weighed every day after the morning's milking and before watering. There was little variation in the weight from day to day, the changes being gradual. There were no changes in the percentage of fat which could be attributed to changes in the food. In the amount of milk and the total amount of fat, however, there were marked changes, as is evident from the following table, which shows the average yield for five days at the beginning and the end of the periods:

Average daily yield of milk and fat on different rations.

	Nutritive ratio.	Dutch.		Swiss.		Angler.	
		Milk.	Fat.	Milk.	Fat.	Milk.	Fat.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds*
End of first period	1 : 8.19	32.49	1.30	29.72	1.05	30.52	0.90
Beginning of second period	1 : 5.42	36.34	1.45	32.30	1.18	32.38	0.94
Difference	....	+3.85	+0.15	+2.64	+0.13	+1.86	+0.04
End of second period	1 : 5.42	31.10	1.20	26.36	0.91	27.57	0.73
Beginning of third period	1 : 4.31	32.37	1.25	27.97	0.96	28.69	0.78
Difference	....	+1.27	+0.05	+1.61	+0.05	+1.12	+0.05
End of third period	1 : 4.31	29.91	2 31	25.74	0.97	27.81	0.77
Beginning of fourth period	1 : 8.19	23.80	1.00	23.24	0.86	24.89	0.62
Difference	....	—6.11	—1.31	—2.50	—0.11	—2.92	—0.15

In the case of every cow the absolute yield of milk and fat increased with the increased consumption of protein, this increase being greatest with the change from the first to the second ration. When in the fourth period the cows were changed back to the wider ration of the first period they all shrunk in yield of milk and fat.

There was a gain in weight on the rations of the second and third periods, and a loss on that of the fourth period, the gain being greatest in the second period. At the close of the third period the Dutch and Swiss cows were nine and ten months advanced in the milking period and the Angler six months.

The results show that it is possible by rich feeding to maintain the yield of milk and of fat well up to the end of the period of lactation; and it is believed that this is more easily done when the heavy feeding is begun early in the period.

In connection with the above experiment a study was made of the digestibility of the chlorophyll and wax in the hay fed. For this purpose the freshly voided manure was dried in a thin layer in a flat porcelain dish over a water bath, and then over sulphuric acid in a partial vacuum, and portions of the ground residue extracted with ether, alcohol, and chloroform. These extracts and others of the hay fed were examined under the microscope and with a spectroscope. The absorption bands of the spectrum showed that in the earlier periods the chlorophyll in the hay appeared in the manure in little if any changed condition even when the food contained very little chlorophyll. Although no absolutely quanitative determinations were made, the author believes that the whole quantity of chlorophyll in the hay was voided in the manure. In the third period, when the proportion of protein was highest, the chlorophyll was more changed and possibly rendered more capable of being resorbed.

The color of the feces has been believed to be largely due to changed coloring matters of the gall, but the absorption bands showed no traces of such materials.

The conclusions of the authors from this part of the investigation are that chlorophyll and the wax-like substances accompanying it are wholly indigestible; that with very rich protein feeding the chlorophyll is more changed and possibly may be more readily resorbed; and that with cows under normal conditions the coloring matters of the gall or their derivatives, especially hydrobilirubin, are not excreted with the manure.—E. W. A.

Feeding experiments with milch cows in Denmark, 1891–'92 (*Syv og tyvende Beretning fra den kgl. Veterin. og Landbohöjsk. Lab. f. landökonom. Forsög., Kjöbenhavn, 1892, pp. 165*).

Synopsis.—Two hundred and forty cows, selected from the herds of eight different estates, were included in the experiments each year. Rations containing varying proportions of grain feed (barley and oats) and oil cakes (one third palm-nut meal, one third rape-seed cake, one third sunflower-seed cake) were compared. There was no change in the chemical composition of the milk with the different rations, while the quantity of milk increased with the heavier oil-cake feeding. The feeding of oil cakes as a part of the ration for milch cows proved profitable.

The experiments reported in this article are the fourth and fifth in a series conducted by the Danish State Experiment Station for the study of the comparative value of certain feeding stuffs for milk production. The plan of the experiment was as follows: The station arranged with the owners of eight different dairy farms to have thirty cows on each farm placed at its disposal for experimental purposes. The cows were to be fed according to the plan previously agreed upon by the station officers and the owners of the animals, and the feed, as well as the milk from each cow, was to be weighed and analyzed. An officer of the station supervised the experiments on each two farms and was present on each of these farms during half of the experimental periods to superintend the weighing of the cows and of the feed and product, as well as the sampling and analysis of the product.

The cows were attended by a "feeder master" appointed by the station, who gave his entire attention to this business. He was present at each milking five days out of every ten-day period, weighed the milk from each individual cow, and, as a check, that from each lot into which the cows were divided. He further attended to the sampling of the milk to be analyzed on the farm by the station assistant, and took the samples of milk from each lot, which were forwarded to the station laboratory for analysis.

The cows in each herd were grouped into three lots of ten each. This division into lots took place during a preliminary feeding period, lasting from twenty to forty days, in which all the cows received the same food and were studied individually. Great care was taken to make the lots perfectly uniform as regards milk yield and production of fat, as well as live weight, age, time since calving, and rate of decrease in milk yield. The success in securing uniformity in the different lots

is illustrated by the following data for the cows in the experiment at the estate Bregentved in 1891:

Statistics for cows in experiment at Bregentved, 1891.

	Lot A.	Lot B.	Lot C.
Average daily milk yield per cow, pounds	27.0	26.9	27.0
Average daily fat production, kvint *	85.6	85.5	85.4
Average live weight, pounds	861	865	873
Average age of cows, years	8.9	8.7	8.7
Average days from calving	83	81	83

* 1 kvint = $\frac{1}{100}$ Danish pound = 4.98 grams.

Similar results were obtained at all the estates. If less uniform lots were secured on the first grouping, new groupings were made until the desired close agreement was reached.

The difficulty encountered in the proper grouping of the cows as regards their milk yield is greatly increased by the fact that two lots giving a similar quantity of milk when the grouping is made may decrease in milk yield at a different rate and after some time become decidedly uneven. This was guarded against by observing the rate of decrease in milk yield of each cow during the preliminary feeding, and taking the data obtained into account in the final grouping of the cows.

The experiment proper was commenced ten days after the final grouping. The feed given all the cows during the preliminary feeding was continued throughout the experiment for one of the lots (lot B). The grain ration for each lot was as follows: Lot A, three fourths grain mixture and one fourth oil cake; lot B, one half of the same grain mixture and one half oil cake; and lot C, one fourth grain mixture and three fourths oil cake. The grain mixture was two thirds oats and one third barley. The oil cake was a mixture of one third palm-nut meal, one third rape-seed cake, and one third sunflower-seed cake. All of the lots received in addition ruta-bagas, hay, and straw.

The grain feed given varied between 6 and 8.4 pounds on the different estates, the relation of grain to oil cake and of concentrated feed to coarse fodder remaining the same throughout the experiment, except the straw, which was fed *ad libitum*. The quantity of ruta-bagas fed varied on the different farms, ranging between 20 and 40 pounds per day per animal, but the quantity fed on each farm remained the same throughout the experiment.

The following statement shows the daily rations fed to the different lots during the experiment of 1892 at Bregentved estate, and illustrates the system of feeding adopted:

Daily ration per cow at Bregentved, 1892.

	Lot A.	Lot B.	Lot C.
	Pounds.	*Pounds.*	*Pounds.*
Mixed grain	6	4	2
Oil cake	2	4	6
Ruta-bagas	20	20	20
Hay	3	3	3
Straw fed *ad libitum*	16	16	16

The experiment proper (first period) lasted for about three months. After an intermission of ten days the feeding was continued for about two months longer (second period) to study the after-effects of the rations fed during the first period and to determine how far the effort to separate the cows into even lots had been successful. During this second period all the cows were fed alike, receiving the same feed that was given to all during the preliminary experiment and to lot B throughout the experiment.

Three different methods of analysis were adopted for the determination of the richness of the milk, viz., the determination of the cream content of the milk of the individual cows by Fjord's centrifugal method, the determination of fat in the mixed milk from each lot by Soxhlet's aërometric method, and by gravimetric chemical analysis. The cream test and Soxhlet's test were made on each farm, while the gravimetric analyses were made at the station laboratory in Copenhagen.

The following are the averages of all the analyses for both years and for all herds:

Average percentage of fat in milk, 1891 and 1892.

	Preliminary period.			Period I.			Period II.		
	Lot A.	Lot B.	Lot C.	Lot A.	Lot B.	Lot C.	Lot A.	Lot B.	Lot C.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
By Soxhlet's method	3.26	3.25	3.26	3.22	3.20	3.22	3.28	3.26	3.28
By gravimetric analysis	3.22	3.20	3.23	3.20	3.17	3.20	3.32	3.31	3.31
By cream test (Fjord)	4.68	4.65	4.66	4.74	4.66	4.67	4.91	4.90	4.91

As in the experiments of previous years it was found that any of the three methods gave uniform results and may be adopted for a comparison of the influence of the feed on the milk.

The influence of the different concentrated feeding stuffs on the quality and the quantity of the milk, on the live weight of the cows, and on the consumption of straw for the different herds is shown in detailed tables covering more than 80 pages of the bulletin.

Composition of the milk.—The following table gives in a condensed form the average chemical composition of the milk for the different lots during the whole experiment.

Average composition of the milk of different lots of cows.

	Experiment of 1891.			Experiment of 1892.			Average of two years.		
	Lot A, ¼ oil cake.	Lot B, ½ oil cake.	Lot C, ¾ oil cake.	Lot A, ¼ oil cake.	Lot B, ½ oil cake.	Lot C, ¾ oil cake.	Lot A, ¼ oil cake.	Lot B, ½ oil cake.	Lot C, ¾ oil cake.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Preliminary period:									
Water	88.01	88.06	88.06	88.25	88.31	88.27	88.13	88.19	88.17
Fat	3.31	3.29	3.30	3.13	3.12	3.15	3.22	3.20	3.23
Casein and albumen	3.01	2.97	2.96	2.97	2.97	2.99	2.99	2.96	2.97
Milk sugar	4.90	4.93	4.92	4.91	4.88	4.85	4.90	4.91	4.88
Ash	0.77	0.75	0.76	0.74	0.74	0.74	0.76	0.74	0.75
Period I:									
Water	88.03	88.03	88.10	88.17	88.26	88.21	88.10	88.15	88.16
Fat	3.24	3.23	3.24	3.16	3.11	3.16	3.20	3.17	3.20
Casein and albumen	3.06	3.07	3.03	3.02	3.01	3.05	3.04	3.04	3.04
Milk sugar	4.89	4.91	4.84	4.90	4.85	4.81	4.90	4.88	4.82
Ash	0.77	0.75	0.76	0.76	0.76	0.77	0.77	0.76	0.77
Period II:									
Water	87.75	87.78	87.80	87.90	87.90	87.91	87.83	87.84	87.86
Fat	3.37	3.34	3.35	3.28	3.28	3.28	3.32	3.31	3.31
Casein and albumen	3.24	3.23	3.19	3.23	3.22	3.24	3.24	3.23	3.22
Milk sugar	4.85	4.87	4.85	4.75	4.72	4.71	4.80	4.79	4.78
Ash	0.77	0.76	0.77	0.77	0.77	0.77	0.77	0.77	0.77

It is plain from the above results that the change in the concentrated food during period I did not cause any material change in the chemical composition of the milk. By comparing the data for the casein and albumen, and for the milk sugar during the different periods, we find a small increase in the former components and a small decrease in the milk sugar for the lots B and C compared with lot A, but this difference, which does not exceed 0.03 per cent, does not appear in the average figures for all estates, and it is fair to assume that it is accidental.

The experimenters give the following summary of their work in this line during the past five years:

"In the comparative feeding trials with milch cows now conducted for five successive years, in which one thousand one hundred and fifty-two cows (divided into one hundred and twelve lots, on nine farms in different parts of our country) have been included, barley and oats have been compared with rutabagas, and with oil cake, grain and oil cake have been compared with rutabagas, and rutabagas have been given as additional food, in all cases it has constantly been observed that the changes made in the food of the cows have shown practically no effects on the chemical composition of the milk."

Milk yield of the cows.—The average quantities of milk produced per cow in ten days during the different periods of the experiment, are given in the following table:

Average daily yield of milk.

	Experiment of 1891.			Experiment of 1892.			Average of two years.		
	Lot A, ¼ oil cake.	Lot B, ½ oil cake.	Lot C, ¾ oil cake.	Lot A, ¼ oil cake,	Lot B, ½ oil cake.	Lot C, ¾ oil cake.	Lot A, ¼ oil cake.	Lot B, ½ oil cake.	Lot C, ¾ oil cake.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Preliminary period	26.6	26.5	26.5	25.3	25.4	25.4	25.9	25.9	25.9
Period I	22.0	23.2	28.4	21.4	22.6	23.0	21.7	22.9	23.4
Period II	19.4	19.8	20.1	20.1	20.5	20.2	19.7	20.2	20.3

The data show that the milk yield increased with the amount of oil cake used in the ration, the average increase over lot A for both years being 12 pounds for lot B, and 17 pounds for lot C. It is noticeable that the increase from one fourth to one half oil cake (A to B) gave better returns than the increase in oil cake from one half to three fourths (B to C), viz., 12 pounds against 5 pounds daily per ten cows. The gain in milk yield and live weight from the partial substitution of oil cake for a mixture of barley and oats, that is, from the substitution of a more nitrogenous food, is expressed by the authors in the following table, which gives the average for eight farms for two years:

Results of substitution of oil cake for barley and oats in rations for milch cows.

	Amount of oil cake substituted for grain mixture, per cow in ten days.	Change per cow in ten days.		
		In milk yield.	In live lot.	In straw eaten.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Comparison of lots A and B: change from $\frac{1}{4}$ to $\frac{1}{2}$ oil cake,	18.5	+12.2	+0.84	−3.8
calculated for 100 pounds of oil cake		+66	+4.50	−21.0
Comparison of lots B and C; change from $\frac{1}{2}$ to $\frac{3}{4}$ oil cake,	18.5	+4.9	−0.01	+2.4
calculated for 100 pounds of oil cake		−26	−0.10	+13
Comparison of lots A and C; change from $\frac{1}{4}$ to $\frac{3}{4}$ oil cake,	37	+17.1	+0.83	−1.4
calculated for 100 pounds of oil cake		+46	+2.20	−4.0

For every 100 pounds of oil cake substituted for the same quantity of mixed grain there was an increase of 66 pounds of milk, provided the oil cake did not constitute more than one half of the grain ration. The experiment therefore showed the oil cake to be of superior value for milk production to the mixture of barley and oats.

In the second period, when all of the cows were fed alike (equal parts of grain mixture and oil cake), the after effect on the milk yield of the more nitrogenous rations was apparent. This bears out the suggestion made by Dr. Ramm in *Landwirthschaftliche Jahrbücher* 21, p. 825, that the influence of a certain ration on milk production should be measured not only by its immediate effect, but also by its after effect during the remainder of the period of lactation. It must be added, however, that the result of the Danish feeding experiments with milch cows during 1887 to 1890, inclusive, do not show any similar tendency.

Live weight.—The average changes in live weight and in the consumption of straw during the different periods of the experiment are summarized in the following table, which shows the average for two years:

Average changes in live weight, and amount of straw consumed.

	Preliminary period.	Period I.		Period II.	
	Average live weight.	Daily gain or loss in weight.	Straw consumed daily.	Daily gain or loss in weight.	Straw consumed daily.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lot A	926	−0.01	11.4	−0.18	10.1
Lot B	924	+0.04	11.8	−0.31	10.2
Lot C	926	+0.04	11.6	+0.25	10.0

In the course of the second period the cows were turned out to pasture and their concentrated food discontinued. For the sake of comparison, the average yield and composition of the milk on stall-feeding and on pasturage are here given. The averages are for all the herds.

Average daily milk yield and percentage of fat in milk on stall feeding and on pasturage.

	Experiment of 1891.		Experiment of 1892.		Average of 2 years.	
	Daily milk yield.	Fat in milk.	Daily milk yield.	Fat in milk.	Daily milk yield.	Fat in milk.
	Pounds.	*Per cent.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*
Lot A:						
Stall feeding	19.4	3.32	19.9	3.21	19.6	3.27
Pasturage	19.4	3.44	20.4	3.35	19.9	3.40
Lot B:						
Stall feeding	19.7	3.30	20.6	3.20	20.1	3.25
Pasturage	19.9	3.40	20.6	3.37	20.3	3.39
Lot C:						
Stall feeding	20.2	3.32	20.4	3.20	20.3	3.26
Pasturage	20.5	3.41	20.1	3.37	20.3	3.39

It will be seen that the yield of milk was usually maintained on pasturage, with a slight increase in the percentage of fat in the milk.—F. W. WOLL.

Effect of food on milk and butter, H. H. DEAN (*Ontario College Sta. Bul. No. 80, Oct. 24, 1892, pp. 8*).—This experiment was made to compare the two following rations: Ration 1, silage 50 pounds, bran 1 pound, hay 5 pounds; and ration 2, silage 50 pounds, pea meal 5 pounds, oatmeal 3 pounds, barley meal 2 pounds, and hay 5 pounds, *i. e.*, with like amounts of coarse fodder, bran was compared with a grain mixture of pea meal, oatmeal, and barley meal. Ration 1 cost 6.35 cents and ration 2, 15.83 cents per day. There were two lots of three cows each. In the first period of five weeks lot 1 received ration 1 and lot 2 ration 2; then they were reversed and fed for a second period of five weeks. The milk from each cow was weighed morning and evening, and a sample was analyzed on four days of each week. Butter was made from the milk of each lot twice weekly, the cream being raised in cold deep setting, and samples of the butter made were rated and analyzed. The richer grain ration (No. 2) increased the yield of milk, but not to a profitable degree. The cost of food per 100 pounds of milk

(average of both lots) was 55.8 cents on ration 1, and $1.18 on ration 2 (richer).

"Both lots lost heavily in weight while getting ration 1 and gained considerably on the silage, meal, and hay (No. 2). The former was not sufficient to sustain the live weight of the animals while giving milk, and the other caused them to lay on flesh without a corresponding increase of milk."

The extra grain "did not affect the per cent of fat in the milk to any great extent," and although the milk from ration 1 creamed slightly better than that from ration 2, "there appeared to be little difference in the average composition of the butter produced on the two rations." For practical use the authors do not recommend either of the rations tried.

"We have found the following ration to give good results: 50 pounds of corn silage, 6 pounds of hay, 4 pounds of bran, and 2 pounds of pea meal and oatmeal mixed in equal proportions. If these latter become too high-priced I would recommend the use of 2 pounds of cotton-seed meal (in place of the bran or meal) per day to each cow, when it can be bought for about $30 per ton."—E. W. A.

Corn silage for making beef, T. SHAW and C. A. ZAVITZ (*Ontario College Sta. Bul. No. 82, Oct. 24, 1892, pp. 8*).—The object of the trial was to compare rations of silage and grain; silage, hay, and grain; and roots, hay, and grain for beef production. The roots were turnips and mangel-wurzels; the grain was a mixture of equal parts by weight of oats, peas, and barley. Each of these rations was fed to one lot of steers from December 16 to May 13, one hundred and fifty days. Lot 1 received silage *ad libitum*; lot 2, 30 pounds of silage and cut hay *ad libitum;* and lot 3, 45 pounds of sliced roots and cut hay *ad libitum.* The animals in each lot received 10 pounds of grain per head daily. One animal in lot 1 died and one in lot 2 was "off feed" for some time. On account of this the results are considered for one steer in each lot. The average daily gain of lot 1 was 1.89 pounds; of lot 2, 1.35 pounds, and of lot 3, 1.62 pounds. Valuing the oats at 26 cents, peas at 50 cents, barley at 40 cents, and sliced roots at 6 cents per bushel, with hay at $9, and silage at $1.75 per ton, the total cost of food for lot 1 was $19.60; for lot 2, $21.06, and for lot 3, $25.86. The steers were bought at 4 cents and sold at 5¾ cents per pound, live weight. Making allowance for attendance and the value of the manure, there was a profit with lot 1 of $24.98; with lot 2, $20.66, and with lot 3, $17.61 per head.

"These experiments have made it pretty clear that silage and grain only do not furnish a ration that is altogether safe in finishing beef cattle; and second, they have proved in a comparative sense the great safety in feeding a ration of which roots is an important factor. Our advice, therefore, in the meantime, to those who are growing roots for this purpose would be to continue to grow them, and to grow corn in addition where this is practicable."—E. W. A.

Peanut cake as a feeding material for cattle, J. A. VOELCKER (*Journ. Roy. Agr. Soc. of England, 3 (1892), ser. 3, pp. 727–730*).—An experiment was made at the Woburn Experimental Farm to compare peanut cake at $10.72 per ton with bean meal at $45.80, for steers. Each material was fed in a grain ration with equal parts of oats and barley, and the animals received besides 45 pounds of roots and 15 pounds of clover-hay chaff per head. The trial lasted one hundred and seven days. The average daily gain in weight per head was 2.19 pounds for the lot on the peanut-cake ration and 2.01 pounds for the lot on the bean-meal ration. "The peanut cake, therefore, proved to be a useful feeding material for cattle and to have a feeding value just about equal to that of beans."—E. W. A.

Experiments in the feeding of steers, J. W. ROBERTSON (*Central Experimental Farm Bul. No. 16, Nov., 1892, pp. 16.*)—Two experiments are reported. The first was commenced in December, 1890, with six two-year-old steers, Shorthorn grades, divided into three uniform lots. From December 1 to 29 all were fed alike. From this date until May 18 the lots were fed as follows: Lot 1, silage 20 pounds, hay 10 pounds, roots 20 pounds, and grain; lot 2, hay 20 pounds, roots 40 pounds, and grain; and lot 3, silage 50 pounds and grain. The grain was alike for all, and was a mixture of oil cake, cotton-seed meal, peas, and barley. Each lot also received 5 pounds of cut straw. The roots were turnips and mangel-wurzels. During the 20 weeks of feeding, the steers on corn silage and grain (lot 3) gained 212 and 221 pounds, respectively, as against 179 and 188 pounds for the lot on hay, roots, and grain (lot 2), and 128 and 182 pounds for the lot on hay, roots, silage, and grain. At the current market prices of feeding stuffs, viz, hay, $8, roots $4, straw $4, oil cake and cotton-seed meal $30, peas $20, and silage $1.40 per ton, the cost of food per head per day was $15.58 for lot 1 (hay, roots, silage, and grain), $19.23 for lot 2 (hay, roots, and grain), and $11.09 for lot 3 (silage and grain).

"A ration of which the bulky-fodder portion was mainly corn silage was more profitable for the fattening of steers than a ration of which the bulky-fodder portion was mainly or wholly hay and roots."

This experiment was repeated in 1891 and 1892, using three lots of two-year-old steers, and feeding for eighteen weeks. The grain was a mixture of oil cake, peas, and barley. As before, the largest gains were given by the lot on silage and grain. Valuing the silage at $2 and the other materials as before, "the cost for feed consumed per 100 pounds of increase in live weight was 62.95 per cent greater for lot 2 (hay, roots, and grain meal) and 48.32 per cent greater for lot 1 (hay, roots, corn silage, and grain) than it was for lot 3 (corn silage and grain.)"

The two-year-old steers fed for three months on silage 50 pounds, straw 5 pounds, and frozen wheat 6 pounds, "gained in weight an average of 159 pounds per head, and consumed on an average 59.88

pounds of feed per head per day, at a cost of 9.32 cents per head per day. The frozen wheat was valued at 35 cents per bushel."

Four three-year-old steers, averaging 1,251 pounds per head in weight, were divided into two lots and fed for eighteen weeks on silage alone and with grain composed of oil cake, peas, and barley, 2 pounds of each. The amount of silage fed was the same for both lots. The steers on silage and grain gained 155 and 102 pounds, respectively, and those on silage alone 7 and 50 pounds, respectively.

Two lots of yearling steers were fed *ad libitum* on silage, roots, straw, and grain from December 1 to April 5, one lot in a cold shed and the other in the stable.

"From this single test, it is not evident that there was an appreciable difference in the increase in the weight of the steers or in the quantity of food consumed, which was due to the place or manner of feeding—stable *vs.* shed and tied *vs.* loose."

Two lots of calf steers were fed *ad libitum* for eighteen weeks on cut hay, roots, and grain, and on silage and grain. There was one Shorthorn and one Quebec-Jersey in each lot. The gains on hay, roots, and grain were slightly larger, but the cost of food per pound of gain was also larger than on silage and grain. The Shorthorn in each case made the larger and cheaper gain in weight.

From a comparison of the results of the above experiments with calves, yearlings, two-year-olds, and three-year-olds, the following conclusions are deduced:

"(1) The cost for feed consumed per 100 pounds of increase in live weight was lowest in the case of calf steers, viz, $4.89 per 100 pounds.

(2) The cost for feed consumed per 100 pounds of increase in live weight was 84.83 per cent greater by the three-year-old steers than by the two-year-old steers.

(3) The original weight of the two-year-old steers was enhanced in value per pound quite as much by the feeding for eighteen weeks as was the original weight of the three-year-old steers.

(4) The original weight of the yearling and calf steers was not enhanced in value per pound to any appreciable extent by the feeding for eighteen weeks.—E. W. A.

Barley and malt as food for sheep, J. A. VOELCKER (*Journ. Roy. Agr. Soc. of England, 3 (1892), ser. 3, pp. 716–723*).—In an experiment at the Woburn Experimental Farm in 1882–'83 it was found that the difference between the feeding value of barley and of the malt and malt dust from a like quantity of barley was very small. In the present trial barley was compared with a mixture of barley and malt, and the effect was tried of adding each of these to linseed cake. There were three lots of twenty-five Hampshire sheep, each about ten or eleven months old. For the ninety-three days of the trial, lot 1 received linseed cake; lot 2 equal parts of linseed cake and barley; and lot 3 a mixture of linseed cake, barley, and malt, in which the linseed cake constituted one half, equal

money values of barley and malt being used. All the sheep received Swedish turnips and clover hay. The cost of the grain food per ton was, linseed cake $49.70, barley $33.95, and malt $67.90. The sheep in lot 1 (linseed cake) made an average daily gain of 0.53 pound, those in lot 2 (barley) 0.45 pound, and those in lot 3 (barley and malt) 0.45 pound. The linseed cake, therefore, led in total gain, and considering the cost the conclusion was that it is more profitable to feed sheep on linseed cake alone than on half linseed cake and half barley, and that there is no advantage from partially substituting malt for barley. The advantage of the linseed cake is still greater when the manurial value is taken account of.—E. W. A.

Fattening lambs, T. SHAW and C. A. ZAVITZ (*Ontario College Sta. Buls. 77 and 78, Aug. 15, 1892, pp. 15*).—An experiment is reported in feeding six hundred and sixty-six lambs, some of which were bought in eastern Ontario and some in Prince Edward Island. The lambs were purchased between August and the last of October, and during the fall were pastured in a large field of rape grown as a second crop. Later they received hay, oats in the sheaf, cut turnips, silage, bran, and a mixture of oats and peas unground. They were fed twice daily, and had access to salt at all times. In the spring one hundred and twenty lambs were sheared. The lambs were sold in lots between January and the middle of April, some in Canada, some in Buffalo, New York, and ninety-nine were sent to England. The price received ranged from 5½ to 7 cents per pound. In calculating the financial results the care and the value of the manure were taken into account, and the feeding stuffs were charged at the following rates: Rape pasturage $8.46 per acre, hay $9, unsheathed oats $6, silage $2, and bran $14 per ton; roots 6 cents, oats 26 cents, and peas 50 cents per bushel. The first cost of the lambs, food, etc., was $3,063.39, and the receipts were $3,698.76, a total profit of $635.37, or 95 cents per lamb, for the winter's feeding.

The ninety-nine lambs sent to England "brought the highest prices that were then paid for choice lambs. They sold well in competition with the best mutton of Wales and Scotland. While sheep brought alive from South America sold for but 6 pence per pound, dressed weight, these lambs brought 8¼ pence per pound." The cost of sending the lambs to England and selling them was $357.69, or $3.61 per head. This included freight, food, care under way, etc. The profit realized on these lambs was $53.67, or 54 cents per head.—E. W. A.

Feeding shorn and unshorn lambs in winter, T. SHAW and C. A. ZAVITZ (*Ontario College Sta. Bul. No. 83, Nov. 21, 1892, pp. 1–6*).—Twenty lambs were divided into two equal lots, and December 3 the lambs of one lot were shorn, the others remained unshorn. From this time until April 12 the two lots were fed alike on a mixture of three parts of oats, two parts of peas, and one part of wheat bran by weight, with sliced turnips, mangel wurzels, and hay *ad libitum*. The valuation

of the feeding stuffs was, hay $9 and bran $14 per ton, oats 26 cents, peas 50 cents, and sliced roots 6 cents per bushel. The unshorn lot made an average gain per head of 43⅓ pounds, and the shorn lambs 31 pounds. They were sold at 7 cents per pound, live weight. The financial result was a profit of $34.46 for the unshorn lot and $34.61 for the shorn lot. The cost of food was practically the same for both, but $5.85 was received for the wool from the shorn lot.—E. W. A.

Feeding lambs on different rations, T. SHAW and C. A. ZAVITZ (*Ontario College Sta. Bul. No. 83, Nov. 21, pp. 7, 8*).—Three lots of twenty-five lambs each were fed from December 31 to April 30, one hundred and twenty days, as follows:

Lot 1, grain mixture of oats, peas, and bran, with sliced roots and hay.

Lot 2, whole oats, sliced roots, and hay.

Lot 3, grain mixture like lot 1, silage, and hay.

In this experiment, therefore, silage was compared with roots, and whole oats with an equal amount of grain mixture. The largest gain was made by lot 2, and the next largest by lot 1. The cost of food per pound of gain was 8.47 cents for lot 1, 7.93 cents for lot 2, and 7.82 cents for lot 3.

"In this experiment the rations with oats alone made mutton more quickly and more cheaply than the ration with oats, peas, and bran. While the ration with silage did not make mutton quite so quickly as the corresponding ration with roots, it made it more cheaply."—E. W. A.

Butter fat in milk and cream, H. H. DEAN (*Ontario College Sta. Bul. No. 76, June 22, 1892, pp. 6*).—This bulletin relates to the payment for milk at creameries on the basis of the fat content of the milk or cream furnished. The author indorses the Babcock test for this purpose.

Observations are also reported on the variation in the percentage of fat in the milk of eight cows from day to day during eight days. "The widest variation in the morning milk during forty-three trials was 0.85 per cent, in the evening milk during twenty-five trials 0.75 per cent, and in the combined morning and evening milk during sixteen trials 0.60 per cent." In a number of cases in which the percentage of solids in milk was determined by analysis and by calculation with the aid of the simplified formula given by Babcock in the Annual Report of the Wisconsin Station for 1891, p. 292 (E. S. R., vol. IV, p. 189), the average difference between the two sets of results was only 0.26 per cent.—E. W. A.

Butter-making on the farm in summer, H. H. DEAN (*Ontario College Sta. Bul. No. 75, June 22, 1892, pp. 7*).—This popular bulletin discusses the precautions to be exercised in the stable and in the dairy, and gives directions for churning and butter-making in general.—E. W. A.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

A modification of Dumas's method of nitrogen determination (*Eine Modification der Dumas'schen Methode zur Stickstoffbestimmung*), F. BLAU.—*Monatshefte Chem., 31, p. 277; abs. in Zeitsch. analyt. Chem., 32, Heft 1, pp. 99–105.*

The direct determination of nitrogen in saltpeter (*Ueber die directe Bestimmung des Stickstoffs im Salpeter*), A. DEVARDA.—*Chem. Ztg., 1892, No. 104, p. 1952.*

Further comments on the Lindo-Gladding method for potash determination (*Kalibestimmung nach der Methode Lindo-Gladding*), T. BREYER and H. SCHWEITZER.—*Chem. Ztg., 1893, No. 7, pp. 101, 102.*

Source of error in the estimation of phosphoric acid with magnesia mixture (*Eine Fehlerquelle bei der Bestimmung von Phosphorsäure mit Magnesia Mixtur*), N. VON LORENZ.—*Zeitsch. analyt. Chem., 32, Heft 1, pp. 64–67.*

Report on the comparative determinations of soluble phosphoric acid by the citrate and the molybdic methods by members of the Association of German Experiment Stations (*Bericht über die Ergebnisse der nach der Citrat und Molybdänmethode von Mitgliedern des Verbandes der Versuchs-Stationen im deutschen Reiche und Vertretern der Phosphat-Industrie ausgeführten Bestimmungen der löslichen Phosphorsäure*), M. MAERCKER.—*Landw. Vers. Stat., 41, Heft 5 and 6, pp. 329–374.*

The action of sulphate of iron on calcium phosphate, P. CAZENEUVE and A. NICOLLE.—*Monit. scientif., 1892, p. 334; abs. in Zeitsch. angew. Chem., 1892, Heft 24, p. 737.*

On the detection and estimation of arsenic (*Ueber den Nachweiss und die Bestimmung des Arsens*), J. THIELE.—*Ann. Chem., 265, p. 55; abs. in Zeitsch. analyt. Chem., 32, Heft 1, pp, 87–94.*

Note on the estimation of hardness of water by soap solution (*Notiz zur Härtebestimmung des Wassers mittelst Seifenlösung*), G. BUCHNER.—*Chem. Ztg., 1892, No. 104, p. 1954.*

A reaction for nitrogenous organic substances (*Ueber eine Reaction stickstoffhaltiger organischer Substanzen*), H. AUFSCHLÄGER.—*Monatshefte Chem., 13, p. 268; abs. in Zeitsch. analyt. Chem., 32, Heft 1, p. 95.*

The inversion of certain carbohydrates (*Ueber die Inversion einiger Kohlenhydrate*), E. WINTERSTEIN.—*Landw. Vers. Stat., 41, Heft 5 and 6, pp. 375–384.*

Water-soluble carbohydrates of malt and barley (*Ueber die wasserlöslichen Kohlenhydrate des Malzes und der Gerste*), G. DÜLL.—*Chem. Ztg., 1893, No. 5, pp. 67, 68, and No. 7, p. 100.*

Determination of sugar with Ost's copper solution (*Ueber Zuckerbestimmung mittelst Ost'scher Kupferlösung*), M. SCHMOEGER.—*Zeitsch. Ver. Rübenzuckerind. 1891, p. 785; abs. in Ber. deut. chem. Ges., 1891, p. 3610, and in Centralbl. agr. Chem., 22, Heft 1, p. 49.*

A sugar prepared from pear pectin (*Ueber eine aus Birnenpektin entstehende Zuckerart*), R. W. BAUER.—*Landw. Vers. Stat., 41, Heft 5 and 6, p. 477.*

The quantitative determination of isomaltose (*Die quantitative Bestimmung der Isomaltose*), A. BAU.—*Wochensch. Brauerei, 9, pp. 1421–1423; abs. in Chem. Centralbl., 1893, I, No. 4, p. 233.*

Estimation of insoluble fatty acids, C. E. CASSAL.—*Analyst, Feb., 1893, pp. 44, 45.*

The distillation of butyric acid, H. D. RICHMOND.—*Staz. sper. agr. Ital., 23, p. 5; abs. in Analyst, Jan., 1893, p. 17.*

Determination of salicylic acid in presence of phenol and its homologues (*Bestimmung der Salicylsäure bei Gegenwart von Phenol und dessen Homologen*), A. FAJANS.—*Chem. Ztg., 1893, No. 5, p. 69.*

Recognition of minute quantities of tartaric acid in citric acid, L. CRISMER.—*Bul. Soc. Chim. de Paris, 6 (1892), ser. 3, p. 23; abs. in Zeitsch. analyt. Chem., 32, Heft 1, p. 96.*

On the quantitative determination of theobromin in the cocoa bean (*Ueber die quantitative Bestimmung des Theobromin in den Cacaobohnen*), P. SÜSS.—*Zeitsch. analyt. Chem., 32, Heft 1, pp. 57–63; abs. in Chem. Ztg., 1893, No. 6, Repert., p. 7.*

A modification of the Reichert-Meissel method (*Ueber eine Modification der Reichert-Meissl'schen Methode*), H. KREIS.—*Schweiz. Wochenschr. Pharm., 30, pp. 481–483; abs. in Chem. Centralbl., 1893, I, No. 4, p. 235.*

Methods of butter analysis (*Notes sur l'analyse in beurre*), L. DELAYE.—*Rev. intern. falsific., 6, pp. 63–65; abs. in Chem. Centralbl., 1892, I, No. 5, p. 282.*

A new fat-extraction apparatus, J. GRAFTIAU.—*Chem. Centralbl., 1893, I, No. 2, p. 73.*

A new drying oven (*Ueber einen neuen Trockenschrank*), M. KÄHLER.—*Chem. Centralbl., 1893, I, No. 2, p. 73, and Chem. Ztg., 1893, No. 3, p. 35, illustrated.*

Copper and iron vessels for laboratory use (*Ueber Kupfer- und Eisenblasen für den Laboratoriumsgebrauch*), R. EBERT.—*Chem. Ztg., 1893, No. 3, pp. 36, 37.*

Laboratory apparatus of aluminum (*Ueber einige Laboratoriumgeräthe aus Aluminium*), G. BORNEMANN.—*Chem. Ztg., 1893, No. 2, pp. 34, 35.*

The best source of electricity for chemical laboratories (*Ueber die zweckmässigste Electricitätsquelle für chemische Laboratorien*), K. ELBS.—*Chem. Ztg., 1893, No. 5, p. 66, and No. 7, pp. 97, 98.*

Proceedings of the annual meeting of the Society of Public Analysts, January, 1893.—*Analyst, Feb., 1893, pp. 25–44.*

The transpiration of scalded shoots (*Transpiration gebrühter Sprosse*), JOSEF BÖHM.—*Ber. deut. bot. Ges., 10, Heft 10, p. 623.*

The intensity of respiration in shade-loving plants (*Ueber die Athmungsintensität von Schattenpflanzen*), ADOLF MAYER.—*Landw. Vers. Stat., 41, Heft 5 and 6, pp. 441–447.*

The daily and hourly assimilation of carbonic acid by beet, turnip, potato, artichoke, oat, summer wheat, corn, and horse-bean plants (*Ueber tägliche und stündliche Assimilation einiger Kulturpflanzen*), W. BROCKS.—*Bot. Centralbl., 51, Nos. 5 and 6, p. 182; abs. in Forsch. Geb. agr. Physik, 15, Heft 5, p. 445.*

Field experiments on fixation of free nitrogen, J. MASON.—*Journ. Roy. Agric. Soc. of England, 3 (1892), ser. 3, p. 651.*

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Some cases of inversion in growth, M. J. MASTERS.—*Journ. Bot., 31, p. 35, figs. 5.*

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seed (*Recherches sur la localisation des huiles grasses dans la germination des graines*), E. MESNARD.—*Compt. rend., 116 (1893), No. 3, pp. 111–114.*

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Sugar materials contained in mushrooms (*Matières sucrées contenues dans les champignons*), E. BOURQUELOT.—*Bul. Soc. Mycol., 1893, No. 1, p. 51.*

The composition of bacteria as influenced by the material in which they grow (*Die Zusammensetzung der Bacterien in ihre Abhängigkeit von dem Nährmaterial*), E. CRAMER.—*Arch. Hyg., 16, Heft 2, pp. 151–195.*

Separation of microörganisms by centrifugal force (*Séparation des microörganismes par la force centrifuge*), R. LEZE.—*Compt. rend., 115 (1892), No. 26, pp. 1317, 1318.*

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Relation between the height of the sea level and the soil temperature (*Der Einfluss der Meereshöhe auf die Bodentemperatur, mit spezieller Berücksichtigung der Bodenwärme Münchens*), E. EBERMAYER.—*Forsch. Geb. agr. Physik, 15, Heft 5, pp. 385–399.*

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Relation between humus formation and lime content of soils (*Ueber die Beziehung zwischen Humusbildung und Kalkgehalt der Bodenarten*), E. W. HILGARD.—*Forsch. Geb. agr. Physik., 15, Heft 5, pp. 400–405.*

The behavior of iron oxide in the soil and in rocks (*Das Verhalten des Eisenoxyds in dem Boden und den Gesteinen*), R. SACHSSE and A. BECKER.—*Landw. Vers. Stat., 41, Heft 5 and 6, pp. 453–466.*

Losses of nitrogen by manures (*Les pertes de l'azote dans les fumiers*), A. MÜNTZ and A. C. GIRARD.—*Compt. rend., 115 (1892), No. 26, pp. 1318–1321, and 116 (1893), No. 3, pp. 108–111.*

Loss of nitrogen from manure (*Deperdition de l'azote des fumiers*), L. DEGRULLY.—*Progrés Agric. et Vitic., 10, No. 6, p. 121.*

The fermentations of manure (*Sur les fermentations du fumier*), A. HÉBERT.—*Compt. rend., 115 (1892), No. 26, pp. 1321–1323.*

The importance of lime and magnesia salts to agriculture (*Die Bedeutung der Kalk- und Magnesiasalze in der Landwirtschaft*), O. LOEW.—*Landw. Vers. Stat., 41, Heft 5 and 6, pp. 466–475.*

The condition of the phosphate market in Germany (*Zur Lage des Phosphorsäuremarktes*), J. H. VOGEL.—*Mitt. deut. landw. Ges., 1892–'93, No. 17, pp. 160–164.*

Report on field experiments in Schleswig-Holstein in 1891 with barley for brewing (*Bericht über die Anbauversuche mit Braugerste in Schleswig-Holstein, 1891*), A. EMMERLING and H. HILBERT.—*Landw. Wochenbl. Schleswig-Holstein, 1892, No. 50, pp. 457–459, and No. 51, pp 465–468.*

Kangra buckwheat.—*Kew Misc. Bul., 73, p. 1.*

A contribution on some species of leguminosæ (*Zur Kentniss einiger Leguminosengattungen*), P. TAUBERT.—*Ber. deut. bot. Ges., 10, Heft 10, p. 637, plate 1.*

Wood ashes as a fertilizer for tobacco (*Die Holzasche als Dünger für Wiesen und Felder, namentlich auch deren Bedeutung für den Tabakbau*), J. NESSLER.—*Wochenbl. landw. Ver. Baden, 1892, No. 22, pp. 255–257; abs. in Centralbl. agr. Chem., 22, Heft 1, p. 64.*

The early formation of gluten in wheat (*Sur le preëxistence du gluten dans le blé*), M. BALLARD.—*Compt. rend., 116 (1893), No. 5, pp. 202–204.*

Empirical formulas for fertilizers for grapevines (*Formules empiriques de fumures pour la vigne*), L. DEGRULLY.—*Progrès Agr. et Vitic, 10, No. 4, p. 73.*

Plaster in viticulture (*Le plâtre en viticulture*), G. BATTANCHON.—*Progrès Agr. et Vitic., 10, No. 5, p. 99.*

Synopsis of species of Canna, J. G. BAKER.—*Gardener's Chron., 13, pp. 43, 70.*

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Yew poisoning, W. CARRUTHERS ET AL.—*Journ. Roy. Agric. Soc. of England, 3 (1892), ser. 3, p. 698.*

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Some new Uredineæ (*Einige neue Uredineen*), P. DIETEL.—*Hedwigia, 1892, Heft 6, p. 288.*

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Finger and toe disease of turnips (*Plasmodiophora brassicæ*), W. CARRUTHERS.—*Journ. Roy. Agric. Soc. of England, 3 (1892), ser. 3, p. 793.*

Disease of chestnut trees (*Maladie des châtaigniers*), L. DEGRULLY.—*Progrès Agr. et Vitic., 10, No. 6, p. 125.*

Canker of larch, W. CARRUTHERS.—*Jour. Roy. Agric. Soc. of England, 3 (1892), ser. 3, p. 792.*

Injurious effects of Phoma betæ on sugar beets (*Ueber den die Zuckerrüben zerstörenden Pilz, Phoma betæ*), FRANK.—*Zeitsch. Zuckerind., 42 (1892), p. 904; Chem. Ztg., 1893, No. 6, Repert., p. 8.*

The repression of Phylloxera (*Die Bekämpfung der Reblaus, Phylloxera vastatrix*), A. LACHMANN.—*Centralbl. agr. Chem., 22, Heft 1, pp. 8–31.*

The origin and multiplication of Ephestia kühniella in the mills of France (*Origine et multiplication de l'Ephestia kuehniella dans les moulins en France*), J. DANYSZ.—*Compt. rend., 116 (1893), No. 5, pp. 207–209.*

Effect of potash salts incorporated in the soil on beet nematodes (*Ueber den Einfluss der dem Boden zu Düngungszwecken einverliebten Kalisalze auf die Rübennematode, Heterodera schachtii*), M. HOLLRUNG.—*Zeitsch. landw. Cent. Ver. Sachsen, Dec., 1892, pp. 419–425.*

Effect of potash salts on beet nematodes (*Einfluss der Kalisalze auf die Rübennematode*), HOLLRUNG. *Zeitsch. Zuckerind., 42 (1893), p. 918; abs. in Chem. Ztg., 1893, No. 6, Repert., p. 8.*

Examination of the residues from the manufacture of peanut oil (*Untersuchungen über die Futtermittel des Handels; III. Rückstände der Erdnussölfabrikation*), P. UHLITZSCH.—*Landw. Vers. Stat., 41, Heft 5 and 6, pp. 385–431.*

At what price and in what amount can dried beet residue be profitably employed as a feeding stuff? (*Bei welchen Preisen und in welchen Mengen kann die Verwendung der getrockneten Rübenschnitzel in der Futterration rathsam erscheinen?*) KREMP.—*Braunschwg. landw. Ztg., 1892, No. 52, pp. 223–225.*

On the mustard oil content of rape and of oil cakes (*Ueber den Senfölgehalt in Raps und Oelkuchen*), A. SCHUSTER and MECKE.—*Chem. Ztg., 1892, No. 104, pp. 1954, 1955.*

The influence of light and darkness on the animal body (*Einfluss von Licht und Dunkelheit auf den thierischen Organismus*), GRAFFENBERGER.—*Pharm. Ztg., 37 (1892), p. 796; abs. in Chem. Ztg., 1893, No. 6, Repert., p. 8.*

Influence of movement on the development of hens' eggs (*Influence du mouvement sur le développement des œufs de poule*), A. MARCACCI.—*Compt. rend., 116 (1893), No. 2, pp. 71–73.*

Analyses of some cheese and milk samples (*Einige Analysen von Käse und Milchproben*), A. STIFT.—*Zeitsch. Nahrungsmitteluntersuch. u. Hyg., 6(1892), p. 454; abs. in Chem. Ztg., 1892, No. 103, Repert., p. 366.*

The "acid butyrometric" method of rapidly determining fat in milk (*Die Acid-Butyrometrie als universal Fettbestimmungs-Methode*).—*Chem. Ztg., 1892, No. 98, pp. 1839–1840.*

On the Pennetier method for recognizing margarin in butter, A. PIZZI.—*Staz. sper. agr. ital., 22, p. 131, 23, p. 38; abs. in Chem. Ztg., 1893, No. 6, Repert., p. 7.*

Various papers on abnormal milk—*Analyst, Jan., 1893, pp. 1–12.*

Is tartar emetic transmitted to the milk? (*Geht Tartarus stibiatus in die Milch über?*) BAUM.—*Monat. prakt. Tierheilkund., 3, Heft 9; abs. in Chem. Centralbl., 1893, I, No. 3, p. 162.*

Tests of various hand milk-separators (*Prüfung verschiedener Handmilchcentrifugen*), J. KLEIN and M. KÜHN.—*Centralbl. agr. Chem., 22, Heft 1, pp. 47–49.*

Concerning the best form of separator for creamery use (*Ein Beitrag zu der Frage, Welches ist die beste Entrahmungsmachine für den Molkereibetrieb?*), ZECHER.—*Zeitsch. landw. Cent. Ver. Sachsen. Dec., 1892, pp. 427–430.*

Cream-collecting creameries in the United States (*Rahm-Sammel-Molkereien in den Vereinigten Staaten von Nordamerika*), A. G. VIETH.—*Milch Ztg., 1892, No. 48, pp. 805–807.*

Per cent of nitrogenous substances in grape must (*Ueber den Gehalt an stickstoffhaltigen Substanzen in Traubenmosten aus dem Anstaltsgut in S. Michele*), E. MACH and K. PORTELE.—*Landw. Vers. Stat., 41, Heft 4, pp. 264–269.*

Experiments on the diminution of the coloring matter in wines by keeping (*Versuche über die Abnahm des Farbstoffgehaltes beim Lagern der Wein*), E. MACH and K. PORTELE.—*Landw. Vers. Stat:, 41, Heft 4, pp. 279–282.*

Changes in the acid and glycerin content of wine during fermentation and during keeping (*Ueber die Veränderungen in Gehalt von gesammt Säure und Glycerin während der Gärung und Lagerung der Weine*), E. MACH and K. PORTELE.—*Landw. Vers. Stat., 41, Heft 4, pp. 270–278.*

Examination of the residue obtained by evaporating wine (*Sur le dosage de l'extrait laissé par l'évaporation du vin*), J. A. MULLER.—*Ann. Chim. et Phys., 27(1892) ser. 6, Nov., pp. 340–352.*

Boric acid as a constant constituent of beer and hops (*Die Borsäure ein steter Begleiter des Bieres und ein wesentlicher Bestandtheil des Hopfens*), J. BRAND.—*Zeitsch. gesammt. Brauwesens, 1892, p. 427; abs. in Chem. Ztg. 1892, Repert. p. 350.*

Improvements in the manufacture of vinegar (*Neuerungen auf dem Gebiete a Essig-Industrie*), O. STEINMETZ.—*Chem. Ztg., 1892, No. 92, pp. 1723, 1724.*

On analysis of beeswax (*Zur Analyse des Bienenwachses,*) R. BENEDIKT.—*Che Ztg. 1892, No. 102, p. 1922.*

Improvements in leather manufacture (*Neuerungen auf dem Gebiete der Lede brikation,*) *Chem. Ztg., 1892, No. 101, pp. 1901–1905.*

EXPERIMENT STATION NOTES.

ARKANSAS STATION.—E. B. Kinsworthy, of Arkadelphia, and J. N. Tillman, of Fayetteville, have been appointed members of the board of trustees, vice H. G. Bunn and W. B. Welch. The substation at Pine Bluff has been discontinued, and a new substation has been established at Camden, in the southern part of the State, where there are pine lands with light sandy soil.

CALIFORNIA UNIVERSITY AND STATIONS.—M. Kellogg has been elected president of the university; R. D. Cruickshank, foreman of the Coast Range station, at Paso Robles, has resigned and H. Tyson has been appointed his successor.

"The station at Berkeley has just completed extensive additions to the orchards and vineyards at the four substations. At the South California station, in Chino Valley, about one hundred new varieties of grapes have been planted, each sort being represented by from twenty to thirty vines. The varieties are chosen with especial reference to the climate, many of the Persian and south of Europe varieties being included. Twenty species of *Vitis* have been sent for trellis and ornamental planting. About 3 acres of new orchard have been planted at this station, all of new sorts, including many seedlings of promise never before sent out. The collections of prunes, walnuts, apricots, peaches, oranges, lemons, and olives at this station are now larger than any private grower possesses and will be of great horticultural importance to southern California.

"The station at Paso Robles in the Coast Range has received large orchard additions in the line of new varieties of deciduous fruits. The vineyard, which bore heavily last season, is already so large that only about thirty kinds could be added with advantage.

"The station at Tulare City in the San Joaquin Valley received trees for about an acre of new orchard and many seedlings, besides new figs and grapes.

"The Sierra Foothill station at Jackson, Amador County, has received trees and vines of new sorts to plant nearly 4 acres, besides new collections of olives, small fruits, etc."

GEORGIA STATION.—The station herd of twelve cows has been successfully dehorned. The operation did not cause fever or diminution in the flow of milk, but made a favorable change in the dispositions of the animals.

IDAHO COLLEGE AND STATIONS.—Since the college opened in October, 1892, about one hundred and thirty students have been in attendance. Three stations have been organized in different parts of the State, at Grangeville, Idaho Falls, and Nampa, and preparations have been made to begin field experiments the coming season. The station staff is constituted as follows: F. B. Gault, president of the University of Idaho; R. Milliken, director, agriculturist, horticulturist, and entomologist; C. W. McCurdy, chemist and botanist; J. E. Ostrander, civil engineer; and I. A. Funk, treasurer.

MAINE STATION.—An analysis of Marvin's Electioneer Brand Horse and Cattle Food by the station chemist indicates that it is made up of linseed meal, with the addition of small quantities of fenugreek, camphor, and ginger, and that, if used according to directions on the packages, it has no special value either as feeding stuff or medicine.

MASSACHUSETTS HATCH STATION.—The Massachusetts Society for Promoting Agriculture has provided for a large extra edition of Bulletin No. 20 of the station, which contains a report on a number of the more important injurious insects selected for description at the request of the society.

MISSISSIPPI COLLEGE.—Bulletin No. 1, issued January, 1893, by W. L. Hutchinson, State chemist, contains notes on the analysis and valuation of fertilizers; tabulated analyses of 45 samples of commercial fertilizers collected during the season of 1892-'93; guaranties of composition filed in the office of the State chemist, 1892-'93; text of the State law relating to fertilizers; and directions for sampling.

OKLAHOMA COLLEGE AND STATION.—The board of regents is at present constituted as follows: R. J. Barker, Stillwater, president and secretary; A. A. Ewing, Kingfisher, treasurer; C. O. Blake, El Reno, attorney; J. E. Quein, Edmond; J. C. Fletcher, Chandler.

SOUTH CAROLINA COLLEGE AND STATION.—J. S. Newman has been appointed acting president and director vice H. A. Strode, resigned; J. S. Pickett has been added to the station staff as foreman of the farm. The board of control consists of M. L. Donaldson, chairman; J. E. Bradley, and D. T. Redfearn.

WASHINGTON STATION.—J. W. Heston has been appointed president and director vice G. Lilley; E. R. Lake, vice-president and horticulturist; J. P. Hendricks, agriculturist, vice J. O'B. Scobey; G. H. Watt, chemist, vice G. G. Hitchcock; and C. V. Piper, entomologist. A small forcing house has been erected, in which investigations on a disease of tomatoes will be undertaken. A herd of seven Holsteins has been added to the farm stock.

AUSTRIAN AGRICULTURAL SCHOOLS.—According to a statement of the Austrian minister of agriculture, published in *Land. u. Forstw. Unterrichtszeitung*, Austria has 102 agricultural schools, classified as follows: Agricultural and forestry schools, 45; agricultural winter schools, 26; dairy schools, 5; nursery schools, 5; schools for gardening, horticulture, and hop culture, 17; schools for brewing, malting, etc., 4. The annual cost of these schools is about $425,000.

SEED CONTROL STATION AT VIENNA.—The report of this station for the year ending July 31, 1892, contains accounts of examinations of seeds of grasses, forage plants, sugar beets, grains, etc. The total number of tests during the year was 2,980.

JAPAN.—This Office has received the Seventh Statistical Report of the Agricultural and Commercial Department, and reports on experiments in rice culture in 1891, and with varieties of wheat, barley, and rape, and with fertilizers for these crops in 1892, at the station at Nishigahara, Tokio. These documents are in the Japanese language.

DAIRY INDUSTRY OF DENMARK.—The preliminary report of C. C. Georgeson, special agent of this Department, gives an account of the methods pursued by the Milk Supply Company of Copenhagen and of a Danish dairy farm near the City of Vordingborg, together with data regarding the trade in Danish butter in the London market. It is stated that the uniformly good quality of Danish butter is largely due to pure cultures of cream ferments which are in common use in all good dairies. These cultures are offered for sale by two or three laboratories and are propagated in skim milk at a given temperature, and are then used for ripening the cream.

DIGESTIBILITY OF PENTOSE CARBOHYDRATES IN FEEDING STUFFS.—*Agricultural Science* for February, 1893, contains an article by Dr. W. E. Stone and W. J. Jones on the digestibility of pentose carbohydrates in feeding stuffs. Dr. Stone has given much study to this class of bodies, and previously reported a short experiment with rabbits on their digestibility. As is generally known, pentose carbohydrates are a class of bodies having the general formula $C_5H_8O_4$, which by inversion yield either arabinose or xylose. They have previously been shown by Dr. Stone to occur in considerable quantities in the nitrogen-free extract of hay and other coarse fodders, hence this information regarding their digestibility forms a valuable contri-

bution to the knowledge of the digestibility of the nitrogen-free extract. From the trial with rabbits it appeared that about 60 per cent of the pentosans were digestible. The present study was made on materials furnished by Prof. Jordan, of the Maine station. These materials consisted of the feeding stuffs used in several digestion experiments with sheep, and the dung excreted. The experiments by Jordan had shown the percentages of digestibility of the different food nutrients of the material, some twenty in number. The experiments of the present series were made especially to determine the percentages of pentosans which had been digested.

This was done by determining the amount of pentosans fed and the amount of the same materials excreted in the dung.

The following table shows the result of the study, giving the percentage of the nitrogen-free extract in the original material, percentage of pentosans in the same, and the percentage of pentosans found to be digested:

Digestibility of pentosans in various coarse fodders.

Kind of food.	Nitrogen-free extract in food.	Pentosans in food.	Pentosans digested.
	Per cent.	*Per cent.*	*Per cent.*
Phleum pratensis:			
Early bloom	51.94	15.65	60.4
Late cut	55.51	16.17	62.8
Early bloom	46.50	12.59	54.6
Late cut	51.11	14.26	48.2
Timothy hay (chiefly Phleum pratensis)	50.17	11.50	48.0
Do	50.16	12.25	49.5
Danthonia spicata	52.07	12.24	68.6
Agrostis vulgaris	53.43	13.27	70.0
Calamagrostis canadensis	45.25	10.81	90.4
Triticum repens	52.94	11.58	59.9
Hungarian grass	47.52	13.70	68.2
Trifolium hybridum	44.39	8.85	56.8
Field corn fodder	52.45	16.46	76.0
Southern corn fodder	46.09	11.52	69.6
Timothy hay and sugar beets	....	....	71.3
Timothy hay and rutabagas	....	....	57.1
Timothy hay and wheat bran	....	....	45.6
Timothy hay and gluten meal	....	....	59.1
Agrostis vulgaris hay and wheat bran	....	....	54.1
Agrostis vulgaris hay and wheat middlings	....	....	64.9

The authors remark in closing: "These results are worthy of consideration. Twenty of the best-known food stuffs for cattle are here shown to contain a minimum of from 6 to 16 per cent of their dry weight in pentosans, of which an average of only 58.2 per cent is found to be digestible. It appears then that while these bodies are to be for the present classified among the carbohydrates, they are really much less digestible, and hence of less food value than the better known members of this group, such as starch, sugar, etc. In many cases the indicated digestibility is even less than that assigned to the fiber of the same material, and the average of all the experiments is but little higher than the corresponding average for the fiber. Indeed from the data at hand it would appear that of all the food constituents capable of digestible estimation, these are among the less soluble in the digestive fluids, although commonly included among those substances which are regarded as in a high degree digestible.

"Not only do pentosans seem to be of low digestibility, but according to Ebstein the pentoses derived from them by hydrolysis (arabinose and xylose), are little if at all assimilated, although readily soluble. He has lately shown that pentose sugars, even in very small quantities, are not assimilated by the human organism. * * * In the light of Ebstein's observations there is, moreover, good reason for believing that even such portions of the pentosans as are dissolved in the digestive tract, are, after all, not assimilated."

FEEDING STUFF FROM MOLASSES.—A company has been formed in Cöthen, Germany, to utilize beet molasses by manufacturing it into a feeding stuff which can be conveniently handled and transported. It has been found that by mixing certain materials with molasses, which also adds to its value for food, a dry, mealy food can be produced. Experiments with this new molasses food by farmers and at some of the experiment stations are said to have given excellent results. Arrangements are being made to manufacture this food in large quantities.

MALLEIN FOR THE DIAGNOSIS OF GLANDERS.—An account of investigations on the use of mallein for the diagnosis of glanders in horses and experiments with the albumose extracted from cultures of the *Bacillus malleus* by E. A. Schweinitz and F. L. Kilborne, of the Bureau of Animal Industry, was published in the *Journal of Comparative Medicine and Veterinary Archives*, vol. 13, No. 11, pp. 643–657.

NEW RUSTS FROM KANSAS.—Two new species of rusts from Kansas are described by P. Dietel in *Hedwigia*, 1892, Heft 6, p. 288. They are *Puccinia chloridis*, parasitic on the leaves of *Chloris verticillata*, and *P. bartholemewii*, on the leaves of *Bouteloua oligostachya*.

BLETTING OF APPLES.—A decay of Beauty of Kent apple is described in *Gardener's Chronicle*, 13, No. 315, p. 47, as follows: The rind becomes entirely black, thickened, and leathery, as though tanned. The flesh becomes a brownish soft pulp, devoid of flavor, and of a gummy consistence. An analysis of the fruit showed an entire absence of malic acid, and the starchy matter had become converted to a semi-gummy substance.

BIBLIOGRAPHY OF AUSTRALIAN ECONOMIC BOTANY.—Part I of a bibliography of Australian economic plants, by J. H. Maiden, has been issued by the Department of Public Instruction at Sidney. It is No. 10 of the Technical Educational Series, and contains the bibliography of the following subjects: General economic plants, exhibitions, foods, forage plants, stock poisons, drugs, eucalyptus and its oils, perfumes and essential oils, gums, resins, kinos, manna, dyes, tans, timbers, fibers, and indexes to authors and subjects.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

JANUARY, 1893.

DIVISION OF STATISTICS:

Report No. 100 (new series), November and December, 1892. Agricultural Production and Distribution of the World; Tests of Averages of Condition; Address of Statistician at Annual Meeting of the Patrons of Husbandry; Reciprocity and Agricultural Exports; European Crop Report for December, 1892; Notes on Foreign Agriculture; Freight Rates of Transportation Companies.

Report on the Crops of the Year, December, 1892.

DIVISION OF ENTOMOLOGY:

Insect Life, vol. V, No. 3, January, 1893.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. IV, No. 4, November, 1892.

Experiment Station Record, vol. IV, No. 5, December, 1892.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS,

JANUARY, 1893.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Bulletin No. 98, December 15, 1892.—Distribution of Seeds and Plants.

Bulletin No. 99, December 16, 1892.—Root Knots on Fruit Trees and Vines; A New Nozzle Tester.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 114, December, 1892.—Notice as to Bulletins; Mixed Fertilizers; Bone and Potash; Nitrogenous Superphosphates and Guanos; Special Manures.

THE DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 14, December, 1891.—Field Tests upon Indian Corn; Combating Insects by Means of Fertilizers; Notes upon a Corn Crambid.

GEORGIA EXPERIMENT STATION:

Bulletin No. 19, December, 1892.—Culture of Tobacco.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 18 (second series).—Analyses of Commercial Fertilizers and Other Substances Useful to Agriculture.

Bulletin No. 19 (second series).—Forage Crops, Grasses, Clovers, and Small Grains.

MAINE STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Annual Report, 1892, part II.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 48, December. 1892.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 88, December, 1892.—Fruit Report.

Bulletin No. 89, December, 1892.—Conformation of Horse, Governing Selection.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:

Bulletin No. 24, October. 1892.—Ornamental and Timber Trees, Shrubs, and Herbaceous Plants in Minnesota.

Bulletin No. 25, December, 1892.—Report on Small Fruit; Renewing Old Strawberry Beds; Shading Strawberry Beds; Seedling Fruits; Analyses of Grapes; Spraying Grapevines.

NEVADA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 18, November, 1892.—Cheese and its manufacture.

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 16, September, 1892.—Common Feeding Stuffs; Various Oils Used in Rations.

Bulletin No. 17, October, 1892.—Stock Feeders' Guide, with Chart for Use in Barn; Standard Grain Mixtures; Standard Rations.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 90, December 8, 1892.—Grasshoppers, Locusts, and Crickets.

Bulletin No. 91, December 14, 1892.—Some Fungous Diseases of the Quince Fruit.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 46 (new series), November, 1892.—Experiments in the Manufacture of Cheese.

Bulletin No. 47 (new series), November, 1892.—Experiments in the Manufacture of Cheese.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 47, December, 1892.—Feeding Lambs and Pigs.

Bulletin No. 48, December, 1892.—Spraying Apple Orchards.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 87*d*, November 26, 1892.—Digestion Experiments with Pulled Fodder, Crimson Clover Hay, Cowpea Vine Hay, Corn Silage, Soja Bean Silage, Raw Cotton Seed, Roasted Cotton Seed, Cotton-Seed Hulls, and Cotton-Seed Meal.

Bulletin No. 87*e*, November 28, 1892.—Meteorological Summary for North Carolina, October, 1892; Brief Statement of Rules for Making Local Weather Forecasts.

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, December, 1892.—Wheat-Growing and Dairying for North Dakota.

OREGON EXPERIMENT STATION:

Bulletin No. 22, January, 1893.—Comparative Test of Small Fruits; Comparative Test of Vegetables; Renovation of Old Orchards.

THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Annual Report, 1891.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 20, December, 1892.—The Production of Capons; Experiments in Caponizing; Prices of Capons, Broilers, Roasters, and Fowls in Boston and New York Markets; When to make Capons, the Time to sell, and How to Prepare for Market; Caponizing Tools and How to perform the Operation.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, December, 1892.—Available Phosphoric Acid and the Water-Soluble Potash in Cotton-Seed Meal. Methods of Preparing Solutions of Cotton-Seed Meal for Precipitation of the Phosphoric Acid; Occurrence of Metaphosphoric Acid and Pyrophosphoric Acid in Cotton-Seed Meal.

VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE EXPERIMENT STATION:

Bulletin No. 20, September, 1892.—A New Fodder Plant, *Lathyrus sylvestris*.

Bulletin No. 21, October, 1892.—Tests of Fertilizers on Wheat.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:

Bulletin No. 33, October, 1892.—Rations for Dairy Cows.

WYOMING AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 9, December, 1892.—Sugar Beets in 1892.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:

Bulletin No. 17, November, 1892.—Cherries.

ONTARIO AGRICULTURAL COLLEGE EXPERIMENT STATION:

Bulletin No. 75, June 22, 1892.—Butter-Making on the Farm in Summer.

Bulletin No. 76, June 22, 1892.—Butter Fat in Milk and Cream.

Bulletin No. 77, August 15, 1892.—Fattening Lambs.
Bulletin No. 78, August 15, 1892.—Fattening Lambs for the British Market.
Bulletin No. 79, August 22, 1892.—Experiments with Winter Wheat.
Bulletin No. 80, October 24, 1892.—Effect of Food on Milk and Butter.
Bulletin No. 81.—Bees in Relation to Fruit.
Bulletin No. 82, October 24, 1892.—Corn Silage for Making Beef.
Bulletin No. 83, November 21, 1892.—Feeding Shorn and Unshorn Lambs in Winter and on Different Rations.
Bulletin No. 84, December 15, 1892.—Experiments with Spring Grain.
Bulletin No. 84, December 22, 1892.—Weeds and Modes of Destroying Them.
Special Bulletin, December, 1892.—The Teaching of Agriculture in the Public Schools.

EXPERIMENT STATION RECORD.

VOL. IV. MARCH, 1893. No. 8.

In a recent bulletin of the Massachusetts State Station (see p. 663) attention is called to two important factors in estimating the value of commercial feeding stuffs, which are very often disregarded by purchasers. One of these is the manurial value. The difference in the value of feeding stuffs in this regard may be very great. At the time the bulletin was prepared, a ton of corn meal costing $24 had a manurial value of $7.31, while an equal amount of cotton-seed meal costing $28 had a manurial value of $23.52. Obviously it would be poor economy to neglect such large differences in making selections of the feeding stuffs on the market. These are familiar matters to our station workers, but there is still great need that the stations, especially in regions where soils demand the liberal use of manure, should continue to urge upon their constituencies the folly of buying feeding stuffs without considering their manurial value.

The other point emphasized in this bulletin is the great variation in the actual value of the same kind of feeding stuff as offered for sale at different times and by different dealers. The extensive use of a variety of commercial feeding stuffs, such as gluten meal, corn germ meal, brewers' grains, and other by-products, is so recent that comparatively few farmers have realized that while these materials may seem on casual examination to be good food for their animals, there may be deficiencies in their chemical composition, which make them almost valueless. The necessity for the analysis of fertilizers is now generally recognized and the regulations governing the trade in fertilizers are increasing in stringency. The inspection of fertilizers, inaugurated and still largely carried on by the stations, has saved the farmers of the country millions of dollars. But the interests involved in the trade in commercial feeding stuffs are greater than in the case of commercial fertilizers. For, as Dr. Goessmann says, "the money invested by farmers for securing commercial feed stuffs as an additional food supply for home consumption, exceeds today many times the amount spent for commercial fertilizers."

Analyses reported in the bulletin show very wide variations in the feeding value of the same kind of feeding stuff. For example, in 22 samples of gluten meal the protein varied from 36 to 25 per cent, and the fat from 12 to 4 per cent; in 35 samples of wheat bran the protein varied from 20 to 15 per cent, and the fat from 6 to 3 per cent; in 4 samples of brewers' grains the protein varied from 33 to 16 per cent, and the fat from 6 to 2 per cent.

"The fact that the majority of this class of feed stuffs are waste or by-products of other industries renders them in an exceptional degree liable to changes in composition. This feature in their production deserves a most careful consideration, from a financial point of view, on the part of the buyer. * * *

"The liability of pecuniary losses on the part of the buyer, in consequence of exceptional variations in the percentage of nitrogenous organic matter, crude protein or fat, or of both, is quite frequently greatly aggravated by most unexpected serious fluctuations in the market cost of leading feed stuffs. * * *

"Names may remain the same, and in fact do remain in some instances, while the composition of the article suffers serious changes in consequence of changes in the parent industry."

For these and other reasons the author of the bulletin believes that the trade in commercial feeding stuffs should be subjected to State inspection in the same way that the fertilizer industry has been. Whether such inspection is necessary or desirable we do not now care to consider. But certainly the attention of farmers should be aroused to the importance of buying only such feeding stuffs as will meet their needs, and of insisting that the dealers in such products should guaranty their composition. When once the agricultural public realize what is really involved in this business they will easily be able to devise methods for its proper regulation.

One feature of the trade in commercial feeding stuffs which calls for special comment is that relating to the so-called "condimental" foods. Recent analyses by the stations have shown that in a number of instances these preparations contain only ordinary food materials mixed with substances of doubtful medicinal value. When a farmer is asked to pay for linseed meal at the rate of $1,000 per ton simply because a harmless quantity of fenugreek has been added to it he probably has some reason to believe that he is being imposed upon. The lordly name which the preparation has assumed will hardly increase the health of his animals or relieve the leanness of his pocketbook. Detective work may not be the highest service which the stations can render to the farmer, but it may be and has been exceedingly useful.

THE RELATION OF THE PHYSICAL PROPERTIES OF THE SOIL TO THE CULTIVATION OF PLANTS.*

DR. EWALD WOLLNY.

If the supply of atmospheric oxygen in the soil is reduced below a certain limit or ceases altogether, the processes of decomposition of organic substances take on an entirely different character, chemically as well as physiologically, from those above described. In case of free access of oxygen the end products of decomposition are carbonic acid, water, and ammonia or nitric acid, but when the supply of oxygen is insufficient or is entirely cut off the following products may result: Carbonic acid, marsh gas, or hydrogen; different organic nitrogenous compounds, as leucin, tyrosin, indol, skatol, and primary amines; ammonia, nitrites, nitrous acid, or free nitrogen; and volatile fatty acids, such as butyric acid. A peatlike mass, designated as "acid humus," is left behind. The kinds of compounds formed vary with the external conditions.

The chemical phenomena of putrefaction, or decomposition with reduction, as this process may be appropriately called, have as yet been comparatively little studied. Nevertheless, the facts already at hand are such as to give a general idea of these phenomena, as will be explained in detail in the following pages.

Carbonic acid always appears among the products of putrefaction, but with a limited supply of oxygen its rate of formation is extremely slow in comparison with that which occurs when the access of air is unhindered. Only a small quantity of oxygen is derived from the putrefying substance itself, and this comes principally from its easily reducible constituents, namely, nitrates, nitrites, nitrous oxide, and also compounds of iron and manganese in their higher oxidation stages. Organic matter, during putrefaction, withdraws the oxygen of all these compounds energetically and under certain conditions, entirely. For instance, reduction of ferrous sulphate in swamps, as Maercker has observed, may go so far as to result in the formation of ferrous sulphide.†

During the changes accompanying putrefaction, a part of the carbon of organic substances appears in the form of marsh gas, and in consequence of the formation of ammonium carbonate the mass is alkaline. Acording to the experiments of Dehérain,‡ this process seems to take

* Continued from p. 543.

† Zeitsch. landw. Cent. Ver. Sachsen, 1874, p. 70.

‡ Compt. rend., 98 (1884), p. 377; 99, p. 45; Journ. de l'Agr., 1884, No. 781; Ann. Agron., 10, No. 9.

place only when oxygen is admitted from time to time. If this gas is continuously absent for a long time the marsh-gas fermentation ceases entirely, and begins anew only when a certain quantity of oxygen is introduced.*

Besides the process just described, still another form of fermentation may take place under certain conditions during putrefaction, which gives rise to the formation of hydrogen instead of marsh gas. This process is characterized by the acid reaction of the substance, which is due to the formation of butyric acid (Dehérain). The presence of this may be easily recognized from the characteristic odor of butyric ether which is produced at the same time. Whether the hydrogen fermentation depends on the access of oxygen from time to time, as in case of the marsh gas fermentation, or whether this process represents that form of decomposition which takes place when oxygen is completely excluded, is still undetermined.

The researches to which reference has been made show that the nitrogenous constituents are changed during putrefaction in part into the sparingly soluble compounds which form the humus, and in part into the nitrogenous substances named above. These latter include nitrogenous organic compounds, ammonia, the lower oxidation stages of oxygen as nitrites and nitrous oxide, and even free nitrogen. The formation of these latter products, which are particularly characteristic of putrefaction, have been the subject of special study by Schlösing, Gayon, and Dupetit,† Dehérain and Marquenne,‡ König and Kiesow,§ Dietzell,‖ Morgen and König.¶

As has already been indicated the volatilization of organic substances, when air is excluded, is comparatively slight, and the greater part of the material forms a more or less solid, dark-colored, peaty mass. This substance once formed changes very slowly, even if completely exposed to the conditions of decomposition with oxidation. As long as organic material is undergoing putrefaction it will become richer in nitrogen and carbon, and poorer in hydrogen and oxygen. Inasmuch as the entire mass loses weight during decomposition, and as the quantity of mineral matter remains unaltered, provided it is not washed out, it is evident that the relative amount of mineral substance in the humus increases as the putrefaction proceeds.** The most of this mineral matter is, however, so inclosed in organic compounds that it is practically incapable of assimilation by the roots of plants which may come in contact with it.

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* Hoppe-Seyler: Zeitsch. physiol. Chemie., 8, p. 214.
† Compt. rend., 95, pp. 644, 1365.
‡ Compt. rend., 95, p. 691.
§ Landw., Jahrb., 1873, p. 107.
‖ Zeitsch. landw., Ver. Bayern, March, 1882.
¶ Landw. Vers. Stat., 30 (1884), pp. 199, 429.
** Compare W. Detmer: Landw. Vers. Stat., 14 (1871), p. 248.

The extent to which microörganisms take part in the oxidation of carbon to carbonic acid has been so explicitly stated in the preceding pages that no further reference to it is needed here. The question now to be discussed is whether the other processes of putrefaction are referable to the same cause, namely, the action of microbes.

The researches of Dehérain show that the marsh gas fermentation is produced by the vital activity of lower organisms, inasmuch as addition of chloroform, or heating at 85° C., arrests the evolution of gas immediately. At the same time the mass remains alkaline and ammonium carbonate is found in the liquid.

It was shown by the same experimenter that the hydrogen fermentation, which is characterized by the formation of butyric acid, is also caused by microbes. Their activity was apparently not dependent on the introduction of air from time to time—distinction from marsh gas fermentation—but seemed to take place when air was excluded. As regards the question whether the marsh gas and hydrogen fermentations were both caused by the action of one and the same ferment, the difference of the action being determined by the constitution of the medium in which the organisms developed, or whether the two kinds of fermentation were due to distinct ferments, it was decided by Dehérain that the latter hypothesis was the more probable, and that generally the one ferment excludes the other. Gayon* also found numerous bacteria in stable manure, which was putrefying without access of air, and under these conditions evolving marsh gas and carbonic acid.

In like manner the reduction of nitrates seems to be a physiological-chemical process, as has been shown to be the case with the opposite process, namely, that of nitrification which results in the formation of nitric acid. The conditions of this reducing process have been studied by Gayon and Dupetit.† These experimenters observed that as microscopic organisms became plentiful in the solutions of nitrates under experiment, the nitrates themselves gradually disappeared. That the microbes caused the reduction of the nitrates is evident from the fact that when the solutions were sterilized by heating, by chloroform, or by sulphate of copper they remained clear and unchanged. These organisms cease their activity entirely or to a marked degree when spread over large surfaces, and thus exposed to the atmosphere. The temperature most favorable to their development lies between 35° and 40° C. These organisms reduce the nitrates until free nitrogen is formed.

Both the investigators observed still another microörganism, which withdrew only one third of the oxygen from the nitrates, thus changing them into nitrites.‡

The morphological characters of the bacteria in question, through

* Journ. de l'Agr., 1884, No. 881, p. 507.

† Compt. rend., 95, pp. 644, 1365.

‡ Compare E. Bréal: Ann. Agron. 18 (1892), p. 181.

whose vital activity the various processes of putrefaction are determined, have not as yet been definitely determined. According to F. Cohn* the *Bacterium termo* is the ferment of putrefaction in the same way that yeast is the alcoholic ferment, but from lack of sufficient observations it is as yet impossible to decide to what extent this hypothesis corresponds to the actual facts. It is probable, however, that various organisms take part in putrefaction; as, for example, it may be assumed with certainty that the *Bacillus amylobacter* of Van Tieghem plays a very important rôle in this process. From a biological standpoint the organisms in question are to be classed with the anaërobic ferments—bacteria which are active only in complete absence or with an intermittent supply of atmospheric oxygen.

The existence and activity of the bacteria which produce putrefaction are of course dependent on their environment, and changes in the latter cause many changes in the phenomena which they manifest. Let us first consider the need of oxygen. The organisms in question, which belong to the strictly anaërobic class, as, for instance, *Bacillus amylobacter*, thrive without oxygen when they are in a favorable medium of growth; for access of oxygen reduces their development to a minimum or arrests it entirely. Nevertheless some forms appear to be able to exist only with an intermittent supply of oxygen. Nencki and Nägeli made the very interesting observation that fermentative bacteria, which increase vigorously without oxygen when placed in a solution well adapted to fermentation, require oxygen for their activity when placed in a less favorable culture medium.

Just as every process of vegetation is dependent on the nature of the surrounding medium, so the fermentative activity of the putrefactive bacteria is controlled by the conditions of temperature. The case here is analogous to that which obtains in decomposition with oxidation. From the data at hand, it appears that when the organisms in question are in a suitable culture medium the range of temperature in which they are able to grow is wide and has a high optimum. For instance, *Bacterium termo* develops between 5 and 40° C.; the optimum is situated between 30 and 35° C. The *Bacillus amylobacter*, according to Fitz, has its optimum at 40° C. and its maximum at 45° C. The temperature of growth with some kinds at least seems to be higher. Numerous bacteria can withstand temperatures below the limit of vegetation without harm; indeed their life persists at temperatures so low, that the range in this direction may be spoken of as unlimited. The upper limit of fatal temperature for the vegetative cells of most forms is about the same as that of the majority of plants, namely, 50–60° C. Some, however, can withstand temperatures of more than 100° C.

From these considerations and the experimental results cited it is plain that the occurrence and activity of the various lower organisms which produce the different processes of decomposition are de-

* Beiträge zur Biologie der Pflanzen, I, p. 169.

pendent on certain conditions. It has been shown that the quantity of air available is a deciding factor of two processes which are of the greatest importance to agriculture, viz, decomposition with oxidation, and putrefaction or decomposition without oxidation.

When oxygen has free access to organic substances up to a certain limit, decomposition with oxidation will take place; but when the supply of air is diminished or cut off altogether decomposition with reduction (putrefaction) will appear. Moreover, it is evident from what has been said of the conditions of decomposition that the functions of the organisms which take part in the fermentative processes are accelerated in proportion as the intensity of the individual determining factors increases; that on reaching a certain limit a maximum of the effect of these functions is attained; beyond this limit it decreases and finally comes to a standstill; or, as a result of the development of large numbers of other organisms to whose multiplication and activity the changed conditions are favorable, the decomposition process may take on an essentially different character.

These considerations make it possible to obtain a correct idea of the relation of the physical properties of the soil to the fermentative processes. The very factors that are the most important for the life of the microörganisms which cause fermentative decomposition are controlled exclusively by the physical conditions of the soil. It is therefore clear that the latter play the largest part in deciding the destiny of the organic material which is contained in the soil or added to it in manures. In fact, the decompositions which are constantly going on in cultivated soil, and which are chemically of such great importance to its fertility, are entirely dependent on the relation of the soil to air, water, and heat.

This principle may be illustrated by examples. In the first place, it is evident that the permeability of the soil to air must be taken into account in order to determine which of the two different processes of decomposition will take place in a given case. In soils of a very fine texture, and which on this account are aërated with great difficulty, especially when they have not been tilled for a long time, or in those which are filled with water during the whole year and thus do not permit access of air, putrefaction of their organic substances takes place as a rule. This process is characterized by a change of the organic matter into a peatlike mass (acid humus) and by a multitude of deoxidation processes which result in the formation of products either useless or harmful to vegetation.

The decomposition of organic matter with oxidation can take place in the soil only when air has access. Agricultural soils may originally possess the needed permeability, as is the case with all soils of a coarse texture—sandy soils for instance—or it may be imparted by suitable tillage. When the soil is tilled regularly and at short intervals, decomposition with oxidation usually takes place in

the tilled surface stratum. At the same time deoxidation processes go on in the deeper, undisturbed subsoil. The occurrence of these two sets of phenomena has given rise to the expression "oxidation stratum" and "deoxidation stratum," as suggested by Mulder.* Evidently the direction which this process takes is of great importance to the fertility of the soil. This will be seen from the fact that the formation of such fermentative products in the soil as are capable of assimilation by the plant, or if not assimilable are harmless, is possible only as the result of decomposition of organic matter with oxidation. Putrefaction, or decomposition with reduction, on the other hand, produces for the most part such compounds as are either difficult of assimilation, *i. e.*, worthless, or positively harmful. When, therefore, a soil originally possessed or in course of time has acquired such a character that its organic constituents undergo putrefaction, the object in cultivation should be to so change the surface stratum as to promote oxidation.

Aside from the permeability of the soil to air, its behavior towards water and heat exerts a determining influence upon the process of decomposition. The smaller the amount of water a soil can hold the slower the fermentation, and conversely. If, however, the quantity of water becomes so great as to reduce the amount of inclosed air to a minimum, putrefaction instead of decomposition with oxidation takes place. The experiments on the influence of heat already cited make it plain that as the temperature of the soil is higher the decomposition of organic material will be accelerated, and in proportion as there is free access of air the quantity of plant food rendered assimilable by decomposition with oxidation will be increased.

From the foregoing considerations the meaning of the terms "active" and "inactive" as applied to soils is evident. An active soil is one in which the conditions are favorable to oxidation. In general it may be assumed that oxidation will go on most rapidly and completely in a soil permeable to air, with a medium moisture content, and at a high temperature. A soil must be characterized as inactive if it offers great resistance to penetration of the air, if it is wet or dry, and if its temperature is low. Between these two extremes various intermediate stages may occur as one or another factor becomes the controling one.

If in accordance with what has been said we may regard it as settled that the processes of decomposition of organic substances are almost entirely determined by the physical properties of the soil, it will also be seen that the influence which these same conditions exert on the chemical processes in the tilled soil extend to the weathering of the mineral components as well as to the behavior of the dissolved substances in the soil.

From a chemical standpoint the process of weathering is of the greatest significance to the fertility of the cultivated soil, inasmuch as its

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* Mulder: Chemie der Ackerkrume. German translation by Müller, Berlin, 1862, 2, pp. 28–34.

rate determines the amount of assimilable plant food which will be formed from the undissolved but soluble minerals of the soil. Bearing in mind that the chemical processes of weathering are accelerated with the increase of oxygen and carbonic acid, it is plain that these processes are dependent, if not entirely, at least in a great measure, upon the physical properties of the soil. The considerations above cited thus explain what are the conditions under which decomposition will be rapid or slow. As the rate of fermentative oxidation is faster or slower, the quantity of carbonic acid formed will be greater or less and the processes of weathering will go on with corresponding activity. The same facts explain why the weathering is so much more rapid in the well aërated surface soil than in the subsoil, in which no considerable circulation of air is possible. Add the fact that the rate of weathering increases with the fineness of the soil, and its physical character becomes of the greatest importance in controlling the processes which go on within it.

The physical properties of the soil exert an influence on the behavior of soluble plant food in that, on the one hand, the absorptive power of the soil for mineral matters, and on the other the amount of loss by leaching is dependent upon them.

In regard to the first of these two points it must be assumed from the recent researches of Van Bemmelen* that besides the absorption of plant food in the soil which is dependent on chemical changes, an absorption due to physical and mechanical causes also exists. This latter results from the presence in the soil of substances of a colloid nature, such as colloidal clay, amorphous zeolithic silicates, colloidal silicic acid, oxides of iron and manganese, humus, etc. These colloid substances have the property of forming a jelly-like mass with water, from which they can be freed only with the greatest difficulty. This colloid substance impregnated with water, or "hydrogel," dries out extremely slowly.

If the air-dried hydrogel is treated with solutions of acids, bases, salts, etc., the water and dissolved substances are, to a certain extent, taken up and the jelly-like mass retains certain constituents, just as if it were vegetable or animal protoplasm. Although the union is a comparatively weak one, it requires repeated addition of water or long-continued washing out to remove the absorbed materials.

The absorption of certain substances depends not only upon the nature of the colloids and of the salts, but also upon the concentration and temperature of the solution. Besides this a certain amount of decomposition of the salts in solutions may be caused by the colloid substance. For example, the hydrogels of iron oxide and alumina withdraw a part of the acid from ammonium salts in aqueous solution. Further chemical substitutions may take place if a hydrogel absorbs a

*Landw. Vers. Stat. 35 (1888), pp. 69-136. Recueil des travaux chimiques des Pays-Bas, 7 (1888), No. 2, p. 37.

salt from its solution and another is dissolved in it. For example, if lime is absorbed by silicic acid and chloride of potassium is added to the solution, more or less of the calcium will be replaced by potassium, and chloride of calcium goes into solution, so that potash, lime, and chloride of calcium will be combined.

The substances which have been described are styled by Van Bemmelen "absorption compounds," and they play a most important part in the absorption phenomena of the cultivated soil. Their general characters, the processes of their formation and decomposition, and their composition are so little understood that researches leading to the discovery of the causes which produce these absorption phenomena would be of the highest value. Still enough has been shown to lead to the assumption that they are dependent on physical instead of purely chemical forces.

For the present purpose it is enough to know that the cultivated soil is provided with substances which, in a mechanical way, assist in retaining soluble plant food, and that the capability of the soil to protect the soluble substances which may be formed in it or added to it from being washed out by the percolating rain water is dependent on the nature and amount of colloid substance present. At the same time it must not be forgotten that purely chemical processes explain part of the phenomena of absorption.

The permeability of the soil to water, and the nature of the soluble substances which it contains, as well as its absorptive power, determine the amount of loss by leaching. As a rule the most of the valuable ingredients of plant food, as potash, ammonia, and phosphoric acid, are absorbed, but nevertheless one of the most important compounds fails to be retained, namely, nitric acid, which occurs in the soil in nitrates, and is formed with extreme rapidity in well aërated soil by the action of microörganisms, as has already been mentioned. Although a part of the nitrates in the soil may be held by physical absorption, still the greater part must remain in solution on account of the easy solubility of all nitrates, so that a chemical absorption is impossible. Aside from the danger of being washed out of the soil entirely, this part of the nitrates is subject to loss by being carried by the percolating water into the subsoil, where it is nearly or quite out of reach of the plant, and finally it may escape in the drainage.

The extraordinary proportions which this loss by leaching may assume were first pointed out by Lawes, Gilbert, and Warington.* In their experiments the loss of nitrogen in form of nitrates from an unmanured field of wheat amounted to 16 to 18.5 kilograms per hectare per annum, and from plats receiving mineral fertilizers alone 19 kilograms. This loss of nitrogen in cultivated land was comparatively high on account of the wet seasons of 1879–'80 and 1880–'81, during which these experiments were conducted. The loss from those plats

* Journ. Roy. Agr. Soc. of England, 17, part 1 and 2; 18, part 3 and 4.

which had received nitrogenous fertilizers was very much higher; it increased with the amount of ammonia salts added, became still larger when only a partial ration of mineral fertilizers had been added to the ammonia salts, and reached an extraordinary amount when ammonia salts alone were added. The use of nitrates resulted in a greater loss than when the equivalent amount was added in the form of ammonia salts. When the ammonia salts were added in the autumn most of their nitrogen was carried away in the drainage during the winter.

The average yearly loss of nitrogen in the drainage for thirty years was as follows: With no nitrogenous fertilizer, 11.3 to 13. 6 kilograms per hectare; with 48.7, 97.4, and 146.1 kilograms of nitrogen in the form of ammonia salts, which were generally added in the autumn, the loss was estimated at 21.5, 35.0, and 47.6 kilograms, respectively; and with 97.4 kilograms of nitrogen, alone or with varying amounts of mineral fertilizers, the losses ranged from 35 kilograms when large quantities of mineral fertilizers were added to 48.9 kilograms when ammonia salts were used alone. The losses varied inversely with the amount of available potash and phosphoric acid.

Such facts as these leave no doubt that one object of cultivation should be to reduce these evils to a minimum, on account of the value of nitrogen in the form of nitrates, in which form it is one of the most important plant foods. Precautions should be taken both to prevent the collection of large quantities of nitrates in the tilled soil, and also to diminish the amount of percolating water.

The danger that large quantities of nitrates may be carried into the deeper strata of the soil increases, other conditions remaining the same, with increase in the amount of water percolating through it, and also with its permeability. Inasmuch as different soils naturally possess this property in differing degrees, the loss of nitrogen from this cause will differ very widely with the physical character of the soil. Furthermore, since penetration by water involves penetrability by air also, the amount of nitrification will vary proportionally. The damage is greatly aggravated when the amount of percolating water is increased, as is the case when atmospheric precipitation is large or the amount of drainage water is made greater by the method of treating the soil, as occurs when the land lies fallow or is covered with inert material which prevents evaporation.

It is evident that the leaching out of plant food by soil water affects the nitrates chiefly, and the amount of loss, other conditions remaining the same, will depend on the absorptive power of the soil and the ease with which water passes through it. It is likewise evident that the physical properties of the soil exert a great influence on the quantity of plant food which it contains. The importance of using such methods of tillage and cultivation as shall best regulate these factors of production needs no further comment.

C. THE RELATION OF THE PHYSICAL PROPERTIES OF THE SOIL TO EACH OTHER AND THEIR RESULTING DIRECT AND INDIRECT INFLUENCE UPON PLANT GROWTH.

In the two preceding chapters the influence, direct and indirect, which the physical properties of the soil—texture, temperature, and moisture—exert individually upon plant growth has been discussed. It now remains to inquire into the laws which govern their conjoint action, since in actual practice the results are the product, not of a single factor, but of the coöperation of many factors.

From analogy it may be concluded that the most favorable conditions will exist in the soil when its mechanical constitution is such as to be most advantageous for each and all of the processes which depend upon access of air, moisture, and heat. This state of things rarely, if ever, occurs in nature. One or more of the conditions of growth which are altered by the three factors just named will always approach in a greater or less degree the minimum or maximum of intensity. What the direct or indirect influence will be under those conditions is a question which may be answered by reference to the laws of vegetable physiology, to various facts of observation, and to investigations made for the special study of the subject.

With reference to the laws which govern plant life, and which have been more or less closely studied, it may be concluded that the development and yield of crops are dependent on those factors of production which, under the existing conditions, act with a minimum or maximum intensity.

This may be illustrated by the following examples: In the case of a sandy soil with only a small water-holding power, neither the high temperature which it usually possesses nor the easy permeability to air is of avail to vegetation because of the lack of water. In the same way a normal water content, that is, one which otherwise would serve for a maximum yield, may fail of its natural effect because the soil is not warm enough, as is often the case on northern exposures; or the water content may be so excessive that the interstices of the soil are filled, free access of air is prevented, and growth is retarded, no matter how favorable all the other physical conditions happen to be. Soil moisture and soil warmth exert such an influence on the plant that the factor which is present in minimum or maximum intensity is the governing one. This naturally applies not only to the factors just mentioned, but to all the physical conditions of the soil which exert an influence upon plant growth. In view of the fact that the optimum of efficiency of a given factor is situated at a mean between the minimum and maximum of its action, as was shown above, it becomes the task of the practical cultivator to so regulate the physical properties of his soil as to bring about the changes most favorable to plant growth.

The activity of the organisms which cause the decomposition of

organic matter is governed by the same general laws. Here also the determining factors are air, light, and moisture. If the influence of all these bears in the same direction they will mutually aid each other, and if all external conditions are favorable the activity of the organisms will reach its maximum. For this reason like quantities of organic substance will decompose with greater intensity in proportion as the temperature and amount of water are increased. A very interesting example of this is presented in the following experiment of the writer* on a compost soil:

Variations of amounts of carbonic acid in the soil with variations of temperature and moisture.

Water content of the soil *	C. c. of carbonic acid in 1000 c. c. of air of soil, at—				
	10° C.	20° C.	30° C.	40° C.	50° C.
Per cent.					
6.79	2.03	3.22	6.68	14.69	25.17
26.79	18.38	54.24	63.59	80.06	81.52
46.79	35.07	61.49	82.12	91.86	97.48

* Percentage of total water-holding capacity.

Under ordinary conditions the several factors do not exert their action in the same direction, but in opposite ones, and on this account the results may vary very greatly in character. Thus, for example, the effect of temperature will be modified or entirely counteracted under certain conditions, if there is not enough water in the soil. A striking example of this is furnished by another experiment of the writer, also with compost soil:

Variations in amounts of carbonic acid in the soil with variations of temperature and moisture.

Temperature of soil	10° C.	20° C.	30° C.	40° C.	50° C.
Water content of soil ... per cent.	46.8	36.8	26.8	16.8	6.8
C. c. of carbonic acid in 1,000 c. c. of air of soil	33.18	62.27	73.23	66.83	14.42

The highest temperatures, 40° and 50° C., could not exert their full influence, because the quantity of water in the soil was insufficient. In like manner the quantities of moisture more favorable to decomposition, viz, 46.8 and 36.8 per cent, did not produce their full effect on account of the low temperature. The other factors, likewise, which determine the activity of soil organisms, are governed by the same principles. From this follows a law of great importance in relation to the decomposition processes of organic materials, viz, the decomposition of organic materials in the soil is governed, quantitatively and qualitatively, by factors which range from minimum to maximum.

*E. Wollny: Journ. Landw, 34 (1886), p. 319.

What the result will be in any given case can be judged only by the application of these principles. For example, no matter how favorable the conditions of warmth and permeability may be, oxidation processes can only proceed slowly when an insufficient amount of water is present. Nor can decomposition with oxidation and nitrification go on energetically, no matter how favorable the conditions of moisture and heat, if the soil is lacking in permeability to air. Keeping in mind the general laws by which these processes are governed, no special difficulty will be met with in determining, under the immediate local conditions, which factor is the controlling one, and consequently what comprehensive and practical measures should be taken.

D. THE SOIL FACTORS OF PLANT GROWTH WHICH ARE ALTERED BY PHYSICAL AGENCIES AND THEIR RELATION TO OTHER FACTORS OF PLANT GROWTH.

It can not fail to become evident from further consideration of this subject that the efficiency of the general factors of plant growth, *i. e.*, light, heat, and plant food is also determined by the physical properties of the cultivated soil, and that the latter act here also, in accordance with the same law which governs them in their direct and indirect influence upon vegetation.

An abundant supply in the soil of the nutritious material which is necessary to the production of the crop and which otherwise would bring a maximum yield, must fail to give the looked-for harvest if the soil contains too little or too much water.

In illustration of this the following experiment by the writer* may be cited: Summer rape was grown in glazed flower pots, each containing 4 kilograms of chalky, sandy soil, rich in humus. To the soil of the different pots different amounts of water were added. The soil of a part of the pots, each of which contained six plants, received no fertilizer, while a mixture of Peruvian guano superphosphate and sulphate of potash was added to the others at the rate of 5 grams per pot. The yield was as follows:

Varying effects of fertilizers upon summer rape with different quantities of water in the soil.

Water in the soil.*	Yield of seeds.			Yield of stalks.		
	Fertilized.	Unfertilized.	Difference.	Fertilized.	Unfertilized.	Difference.
Per cent.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
10	1.3	0.4	0.9	10.0	2.8	7.2
20	5.2	1.2	4.0	14.0	6.0	8.0
40	11.2	3.6	7.6	30.8	13.2	17.6
60	21.2	6.0	15.2	51.2	26.0	25.2
80	15.2	4.8	10.4	37.2	23.6	13.6
100	3.2	1.6	1.6	10.8	10.0	0.8

* Percentage of the amount which the soil would contain when completely saturated.

* E. Wollny: Der Landwirth, 76 (1890), p. 463.

When the water content of the soil was either too large or too small the effect of the fertilizer was only partial, but with a medium amount of moisture—the optimum, or condition as regards moisture most favorable to growth—the most marked effect of the fertilizer on the yield was obtained.

In further experiments to determine the influence of the physical properties of the soil upon the utilization of fertilizers by the plant, wooden boxes 30 cm. square and 20 cm. deep, with perforated bottoms, were sunk to the top in sand. The boxes were filled with sifted sand, all from one source, but of different degrees of fineness. Guano, at the rate of 10 grams per box, was added in some of the boxes, while the others remained without fertilizer. Nine stalks of summer rye were grown in each of the boxes. The yield is given in the following table:

Effects of fertilizers on the growth of rye in soils of different degrees of fineness.

Fineness of soil.	Yield of grain.			Yield of straw.		
	Fertilized.	Unfertilized.	Difference.	Fertilized	Unfertilized.	Difference.
Mm.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
0.00-0.25	10.95	2.18	8.57	29.7	9.0	20.7
0.25-0.50	4.95	1.25	3.70	17.4	6.5	10.9
0.50-1.0	4.61	1.18	3.43	13.2	5.5	7.7
1.0 -2.0	2.20	0.82	2.38	7.7	3.0	4.7
2.0 -4.0	1.34	0.49	0.85	5.7	3.0	2.7
4.0 -6.75	1.22	0.24	0.98	5.5	1.2	7.3

The influence of the fertilizers became more and more marked with the increasing fineness of the soil, because, without doubt, its supply of moisture increased in the same proportion.

The fact that plant growth is favored by increasing the thickness of the tilled stratum is in the main to be accounted for in the same manner (provided the roots do not penetrate into the subsoil), inasmuch as the absolute quantity of water which is at the disposal of the plant is thus increased by the deeper tillage. Furthermore, the deeper the tilled stratum is, the better the roots are enabled to spread over a large area, and thus to utilize the moisture and plant food at their disposal. From this the conclusion may be drawn *a priori* that the action of the fertilizer will be increased with the depth of the tilled stratum.

In fact, this is the case, as is shown by the following experiment of the writer: The surface soil of an area of 32 square meters, which was about 35 cm. deep and consisted of a chalky, sandy humus, was removed from the porous subsoil of calcareous gravel. This area was then divided by strong boards at right angles to each other into eight parcels, each containing 4 square meters. Directly upon the subsoil, which was partly artificial and was thoroughly permeable, a surface soil was relaid. The eight plats were divided in four pairs. The surface soil in the different pairs was 40, 30, 20, and 10 cm. deep, respectively. Four plats, one of each pair, were left without fertilizer, while to each of the other four was added a mixture of Peruvian guano superphos-

phate and sulphate of potash at the rate of 250 grams per plat. The yields of summer rape from the several plats, taken from a row (distance between rows 25 cm.), which had received the same tillage in all the plats, were as follows:

Effect of depth of tillage upon action of manures and yield of crops of summer rape.

Thickness of the tilled stratum.	Yield of seed.		
	Fertilized.	Unfertilized.	Difference.
Cm.	*Grams.*	*Grams.*	*Grams.*
40	672.2	551.5	120.7
30	449.5	348.0	101.5
20	244.5	160.0	84.5
10	148.3	107.0	41.3

In this case the effect of the fertilizer became more marked as the quantity of soil at the disposal of the plant was increased.

The physical properties of the cultivated soil influence the action of the other factors of growth in the same manner as they do the action of the supply of nutritive materials. Thus, in general, leaving out of account the factor of plant food, light and heat can have their full effect only in proportion as the mechanical condition of the soil is such as to insure a sufficient supply of water to the crop. Otherwise, however favorable may be the light and heat, the development of the plants will be retarded to an extent dependent on the condition of the soil.

An experiment by the writer illustrates the part which the moisture content of the soil plays under these conditions. The arrangement of the experiment was as follows: Summer rye was grown in pots containing a chalky, sandy, humus soil, which contained water to the extent of either 20, 40, or 60 per cent of its entire water-holding capacity. The pots, each containing seven plants, were divided in three series, each series being made up of pots with the three different proportions of water. One of these series was placed in each of the three divisions of a glass house. In these divisions a special contrivance made it possible to provide for light of different degrees of intensity.* The yields of the experiment were as follows:

Effects of different amounts of soil moisture upon the yield of rye with different amounts of light.

Water in soil.	Yield of grain.			Yield of straw.		
	Strong light.	Medium light.	Weak light.	Strong light.	Medium light.	Weak light.
Per ct.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
20	4.1	3.3	2.2	6.9	6.2	6.6
40	8.1	6.6	5.9	23.9	15.2	12.6
60	11.9	10.0	7.3	28.4	12.6	13.5

*The temperatures of the three compartments showed a gradation corresponding to the intensity of the light, although less pronounced.

The intrinsic productive capacity of the plants with the aid of the light was manifested in proportion as the soil contained an abundant or medium quantity of water. As long as the water supply was insufficient—40 and 20 per cent—the supply of light had little effect, because the water, which is an indispensable factor of vegetation, was present in too small quantity, and in accordance with the law of the minimum, this completely regulated the production of organic substance.

It is hardly necessary to bring forward further proof that the physical properties of the tilled soil and the influences which they exert are determinative for the utilization by the plant of the nutritive material of the soil and for the other factors of vegetation. If the one set of conditions does not supplement the other the yield of the crop will be diminished, and treatment which would otherwise be the most conducive to growth will fail of its full effect. Such considerations as these and the array of facts which have been brought forward lead to the conclusion that the law of the minimum of each of the factors of vegetation indispensable to the plant extends to the fulfillment of the several physical conditions of growth (Orth.).* [Or, to state the principle in another way, the yield of a crop is limited by the chemical factors of growth, including the soil ingredients of its food, and it can not rise above the limit determined by the lowest element in the food supply. In like manner the yield is regulated by the physical factors, air, moisture, and heat, and can not exceed the limit imposed by that one of these factors which has the minimum efficiency.—Ed.]

*Forsch. Geb. Agr. Physik, 1 (1878), p. 72.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

BOTANY.

A. C. TRUE, *Editor.*

Flora of West Virginia, C. F. MILLSPAUGH (*West Virginia Sta. Bul. No. 24, June, 1892, pp. 315–537, plates 2*).—A preliminary catalogue of the plants of West Virginia, compiled from various sources. In addition to the enumeration of the species the author gives the collectors and places of collection. Two new mosses (*Dicranodontium virginicus* and *D. millspaughi*), a new scale moss (*Plagiochila virginica*), and a new fungus of insects, probably parasitic, to which is given the name *Cylindrocola dendroctoni*, are described, the mosses by Mrs. E. G. Britton, the hepatica by A. W. Evans, and the fungus by C. H. Peck. The second species of moss and the hepatica are illustrated.

Of Anthophyta there are enumerated 504 genera, represented by 1,321 species; of Pteridophyta, 15 genera and 44 species; of Bryophyta, 66 genera and 113 species; and of Thallophyta, 94 genera and 167 species, making a total of 679 genera, represented by 1,645 species and varieties. Of the latter number 193 are introduced and 1,452 native species and varieties. The author has adopted 1753 as the fundamental date in determining the priority of names and has given double citations of authors as far as he was able to do so. Among the well-known genera affected by a strict adherence to this law of priority are the following: *Syndesmon thalictroides* (*Anemonella thalictroides*), *Bicucullа* (*Dicentra*), *Neckeria* (*Corydalis*), *Cardamine* (*Dentaria*), *Ampelideæ* (*Vitaceæ*), *Vitis quinquefolia* (*Ampelopsis quinquefolia*), *Beurera* (*Calycanthus*), *Therofon* (*Boykinia*), *Micrampelis echinata* (*Echinocystis lobata*), *Deeringia* (*Cryptotænia*), *Lacinaria* (*Liatris*), *Ridania* (*Actinomeris*), *Adopogon* (*Krigia*), *Oxycoccus macrocarpus* (*Vaccinium macrocarpon*), *Psera* (*Chimaphila*), *Hypopitys monotropa* (*Monotropa hypopitys*), *Asperifoliæ* (*Borragineæ*), *Physalodes* (*Nicandra*), *Koellia* (*Pycnanthemum*), *Agastache* (*Lophanthus*), *Hicoria* (*Carya*), *Malaxis* (*Microstylis*), *Leptorchis* (*Liparis*), *Gyrostachys* (*Spiranthes*), *Unifolium* (*Smilacina*), *Chrosperma* (*Amianthium*), *Spathyema* (*Symplocarpus*), *Chamæraphis* (*Setaria*), *Homalocenchrus* (*Leersia*), *Sieglingia* (*Triodia*), *Hystrix* (*Asprella*), *Corycarpus* (*Diarrhena*), and *Panicularia* (*Glyceria*).

The specific changes are too numerous to list in this connection. A supplement (pp. 519–527) gives a list of the fossil flora, containing 37 genera and 199 species and varieties. The material for this list was largely contributed by R. D. Lacoe.

WATER.

Analysis of water, W. C. STUBBS (*Louisiana Stas. Bul. No. 18, 2d ser., pp. 528, 529*).—Analysis of 1 sample of water to determine its fitness for stock.

FERTILIZERS.

W. H. BEAL, *Editor.*

Fertilizer analyses at Louisiana Station, W. C. STUBBS (*Louisiana Stas. Bul. No. 18, 2d ser., pp. 506–528*).—This contains a list of licensed dealers, with guarantied analyses of their brands; the text of the State fertilizer law; a discussion of the nature and source of fertilizing materials; notes on valuation, and tabulated analyses of 48 samples of fertilizing materials, including ammoniated superphosphates and guanos, acid phosphates, cotton-seed meal, tankage, bone meal, mineral phosphates, fish scrap, dried blood, sulphate of ammonia, nitrate of soda, nitrate of potash, kainit, sulphate of potash, muriate of potash, gypsum, cotton-hull ashes, bat manure, and poudrette.

Commercial fertilizers, M. A. SCOVELL (*Kentucky Sta. Bul. No. 43, Dec., 1892, pp. 4*).—Tabulated analyses and valuations of 4 samples of raw bone manures and 16 samples of other fertilizers and superphosphates.

Inspection of fertilizers in Connecticut (*Connecticut State Sta. Bul. No. 114, Dec., 1892, pp. 26*).—Analyses of 115 samples of commercial fertilizers, with notes on guaranties and valuation.

Of the 46 brands [of nitrogenous superphosphates] reported 11 are below their minimum guaranty in respect of one ingredient, and 4 in respect of two ingredients. That is, one third of all the nitrogenous superphosphates in our market contain less of one or of two ingredients than they are claimed to contain. * * *

The average cost of the nitrogenous superphosphates, excluding two analyses in which cost exceeds valuation by considerably more than 50 per cent., is $35.28; the average valuation, $25.46; and the percentage difference, 27.8. Last year the corresponding figures were: Average cost, $33.93; average valuation, $28.13; percentage difference, 20.6. * * *

Of the 39 brands of special manures analyzed, 16 are below the manufacturer's minimum guaranty in respect of one ingredient, and 1 is below in respect of two ingredients.

The average cost per ton of the special manures has been $38.28, the average valuation $30.70, and the percentage difference 25, a little higher than in case of the nitrogenous superphosphates. Last year the corresponding figures were: Average cost, $38.84; average valuation, $31.64; percentage difference, 22.8.

FIELD CROPS.

A. C. TRUE, *Editor.*

Field experiments with corn, A. T. NEALE (*Delaware Sta. Bul. No. 14, Dec., 1891, pp. 3–12*).

Synopsis.—A report on (1) a test of Early Mastodon, (2) experiment in detasseling, and (3) fertilizer test. Early Mastodon gave good yields and large ears. Detasseling increased yield and weight of ears. Nitrate of soda seemed to enable young plants to resist insect attacks.

Test of Early Mastodon variety.—This variety is said to be a cross between White Cap and Early Roe dent, and the claim is made by seedsmen that it grows to a height of 15 to 17 feet, with ears 9 to 11 inches long and carrying 20 to 34 rows of kernels, and that it matures within one hundred days. It was planted at Dover on a sandy loam and at Newark on heavy clay. At Dover the yield per acre was from 54 bushels on unfertilized plats to 76 bushels on plats fertilized with nitrate of soda and muriate of potash, the average being 66 bushels. At Newark the yield was 62 bushels per acre. About one hundred and twenty days were required to grow the crop. The ears averaged 8 to 9 inches in length. Approximately 40 per cent of selected ears had more than 20 rows of kernels per cob. A dry ear with 24 rows measured 2½ inches in diameter, 3 inches from the large end. Of this diameter one half was occupied by the cob.

Detasseling.—The tassels were removed from about half the stalks on a plat at Newark. It was calculated that an increased yield of 4½ bushels was caused by detasseling. The ears on stalks not detasseled averaged about 11 ounces in weight and those on the detasseled stalks 16 ounces.

Fertilizer test.—Notes and tabulated data are given for an experiment with various fertilizers on corn. The results were materially affected by the ravages of a new insect pest, a corn crambid, described on page 662. There were indications "that nitrate of soda aided the young corn plants in resisting the attacks of insects."

Experiments with cotton, 1892, A. J. BONDURANT AND J. CLAYTON (*Alabama College Sta. Bul. No. 40, Jan., 1893, pp. 15*).—An account of a test of varieties and of experiments with different kinds of fertilizers.

Test of varieties.—Tabulated data for 30 varieties. The larger yield of seed cotton by the short staple varieties was more than counterbalanced by the higher price obtained for the long staple cotton. The highest valuations were put upon W. A. Cook, Colthorp Eureka, and Wonderful. Catacaos or Peruvian cotton failed to mature.

Experiments with fertilizers.—An experiment with acid phosphate alone and combined with cotton-seed meal, begun in 1890 and reported in Bulletins Nos. 22 and 32 of the station (E. S. R., vol. II, p. 548, and

III, p. 684) was continued in 1892 without the additional application of fertilizers. The results indicated that the effect of the cotton-seed meal had been exhausted but that the acid phosphate still continued to increase the yield.

In an experiment with different forms and combinations of fertilizers, nitrogen alone produced a very much larger increase of yield than either phosphoric acid or potash. The largest yield was obtained with a complete fertilizer, closely followed by that with stable manure. A combination of acid phosphate and cotton-seed meal (240 pounds of each per acre) was the most profitable fertilizer.

A compost of acid phosphate, stable manure, and cotton seed when applied February 24 gave a somewhat larger yield than when applied May 9, just before planting.

Tabulated data are also given for experiments in which acid phosphate was compared with raw phosphate, and salt, muriate of potash, kainit, and Thomas slag were used separately.

Field experiments with forage plants, barley, oats, and wheat, W. C. STUBBS (*Louisiana Stas. Bul. No. 19, 2d ser., pp. 536–562*).—An account of experiments with a large number of species and varieties of forage plants and grain, most of which were carried on at all three of the stations in Louisiana.

Forage plants.—Ten or 12 saccharine varieties of sorghum out of over 100 varieties grown for sugar-making have been used for green fodder. The varieties recommended for this purpose are Early Amber, Early Orange, Coleman Hybrid, and Link Hybrid, which can be cut in succession through the season. The following non-saccharine sorghums have been successfully grown at the three stations: Kaffir corn, millo maize (white and yellow), durra (white), Egyptian wheat, Egyptian rice corn, and Jerusalem corn. Teosinte grows well throughout the State and yields a very large amount of green fodder (over 50 tons per acre at Audubon Park). Pearl and German millets have been found useful. Golden Wonder millet is deemed worthy of extensive trial. Japanese, European, and American Silver Hull buckwheat have produced large amounts of forage and sometimes (but not in wet seasons) of grain. The Japanese variety is decidedly the best. When mixtures of the above-mentioned crops, except buckwheat, were spread before horses, mules, and cows, they were eaten in the following order: (1) Saccharine sorghums, (2) teosinte, (3) pearl millet, (4) millo maize, and (5) Jerusalem corn, Kaffir corn, and Egyptian corn.

Descriptive notes are given on 17 varieties of cowpeas which grew luxuriantly throughout the State. Of these, Unknown, Clay, and Black are especially adapted to green manuring. "Unknown is a late, but prolific bearer of seed. For table purposes some of the white bunch varieties are preferred." *Lathyrus sativus* and *L. sylvestris*, as grown at the stations, "are strangely alike in appearance and habits of growth." The latter is now growing "moderately well." "It has been

with great difficulty that any of this genus has been grown. They appear delicate when young and are easily crowded out by native grasses when sown in spring unless carefully protected. Planted in the fall they grow but little in the winter and still require protection in the spring." *Vicia sativa*, *V. villosa*, and an undetermined species, known as Chinese, have grown fairly well when sown in the fall and have given one cutting of hay of medium quality. Alfalfa grown on alluvial land at Audubon Park has given six or seven large cuttings of hay each year; at Baton Rouge it has done fairly well but at Calhoun it has made a sickly growth even with fertilizers. Other species of *Medicago* are of comparatively little use. Crimson clover planted in the fall will give two or more crops of hay if cut before blooming, but requires reseeding annually. Red clover does fairly well and white clover grows luxuriantly in southern and central Louisiana. Japan clover (*Lespedeza striata*) has proved valuable for hay or pasture in northern and central Louisiana. Beggarweed (*Desmodium molle*) grows luxuriantly, but the hay is "woody."

The following have proved partial or total failures: Lupines, sainfoin, serradella, soja beans, sulla (*Hedysarum coronarium*,) kidney vetch (*Anthyllis vulneraria*), Bokhara clover, and alsike clover.

Brief notes are given on 39 species of grasses sown in the fall and 47 sown in the spring. The following are recommended for trial: (1) Sown in the fall—redtop (*Agrostis vulgaris*), tall meadow oat grass (*Arrhenatherum avenaceum*), *Avena sterilis*, Japanese rye grass (*Agropyrum japonicum*), *Bromus pinnatus*, rescue grass (*Bromus unioloides*), orchard grass (*Dactylis glomerata*), Italian rye grass (*Lolium italicum*), *Phalaris cærulescens*, and Texas blue grass (*Poa arachnifera*); (2) sown in the spring—*Chloris schwartziana*, *Panicum palmeri*, *Andropogon annulatus*, and *Cenchrus montanus*.

The following analyses were made of samples of forage plants at Baton Rouge:

Analyses of forage plants.

	Water.	Protein.	Fat.	Fiber.	Nitrogen-free extract	Ash.
	Per cent	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Kentucky blue grass (*Poa pratensis*)	12.15	8.00	3.35	23.56	42.78	10.16
Orchard grass (*Dactylis glomerata*)	12.82	7.82	3.70	28.35	36.56	10.75
English rye grass (*Lolium perenne*)	14.23	7.78	3.24	25.11	39.02	10.52
Timothy (*Phleum pratense*)	14.51	8.38	3.48	29.63	34.25	9.75
Redtop (*Agrostis vulgaris*)	14.14	7.88	3.66	23.52	38.26	11.54
Tall meadow oat grass (*Arrhenatherum avenaceum*)	13.55	7.94	3.99	23.65	40.62	10.25
Velvet or meadow soft grass (*Holcus lanatus*)	12.76	10.50	3.65	26.45	34.59	12.05
Burr or California clover (*Medicago maculata*)	11.15	12.65	4.15	31.76	30.97	9.32
Alfalfa or lucern (*Medicago sativa*)	10.94	12.25	3.51	31.05	34.09	8.16
Red clover (*Trifolium pratense*)	12.85	14.87	5.49	25.28	32.07	9.44
Crimson clover (*Trifolium incarnatum*)	13.37	14.04	4.06	26.25	29.30	13.00
Texas blue grass (*Poa arachnifera*)	10.68	11.76	4.21	30.28	34.35	8.72

Barley.—A brief account of a fertilizer test with Rust-Proof and Winter Grazing barley. The former variety gave much the larger yields in every case. Cotton-seed meal (200 pounds) and acid phosphate (100 pounds) applied at planting were effective fertilizers.

Oats.—This crop has been successfully grown for several years at all the stations by using pure "rust-proof" seed and planting in October. Relatively large yields have been given by Red Rust-Proof, Virginia Gray Winter, Beardless Rust-Proof, and Prince Edward Island. At Audubon Park two crops of fodder and one of grain are obtained from a single planting.

Wheat.—Tabulated data are given for 103 varieties grown at Calhoun from seed obtained at the California Station and 13 varieties from Louisiana seed. All the varieties from California failed at Baton Rouge. The following gave profitable yields at Calhoun: Fulcaster, Ghuka or Odessa, Tuscan Island, White Boughten, Mediterranean, Red Russian, Harris, Russian Red Bearded, Mold White Winter, Good Wheat, Purple Straw, Winter Genoese, and Fulcaster Winter.

Lathyrus sylvestris, E. A. SMYTH, JR. (*Virginia Sta. Bul., No. 20, Sept., 1892, pp. 87–91*).—A compiled account of flat pea (*Lathyrus sylvestris*), which the station proposes to test. The following analysis by the station chemist was made from plants grown in the State: Moisture, 6.31 per cent; dry matter, 93.69; in dry matter—ash, 6.92; protein, 18.75; fiber, 34.90; nitrogen-free extract, 35.71; fat, 3.72.

Sugar-beet culture in Arkansas Valley, F. L. WATROUS (*Colorado Sta. Bul., No. 21, Oct., 1892, pp. 3–7*).—Notes and tabulated data for experiments at the substation at Rocky Ford, which indicate that with careful cultivation and proper irrigation sugar beets may be successfully grown in this region.

Potato culture in Arkansas Valley, F. L. WATROUS (*Colorado Sta. Bul. No. 21, Oct., 1892, pp. 8–11*).—An account of endeavors to raise potatoes in a region where it was popularly supposed that this crop would not grow.

The method used during two seasons with considerable success is described as follows:

On land occupied by sugar beets the season previous, straw was placed to a depth of 8 or 10 inches. June 5 the following season, the straw was burned and the ashes plowed under at once. Then on the 9th and 10th one fourth of an acre was planted to seed of Mammoth Pearl and another fourth acre to Rose Seedling. The seed was cut in large-sized pieces, with one and two eyes, and planted in furrows 4 to 6 inches deep.

As soon as tops appeared above the ground, a light harrow was brought into use, and this was continued at intervals of a few days until the tops were so large as to make the work injurious, after which time they were cultivated with a small, fine-toothed cultivator. When the ground was partially shaded by tops, a furrow was run between each two rows from north to south. On August 14, when plants were in blossom, the ground being dry, irrigation was commenced. The water was confined to furrows and allowed to run long enough to moisten the rows quite thoroughly. By this time the roots were spreading so far that cultivation would have

been injurious, so that in order to keep the soil in healthy condition it was necessary to irrigate about once a week for the remainder of the season, which was done.

Potatoes were harvested October 7. The plat of Rose Seedlings produced at the rate of 108 bushels per acre. The plat of Mammoth Pearl at the rate of 252 bushels per acre. These potatoes in both instances were of most excellent quality. * * *

There is yet much work to be done in this line, but in the mean time it is believed any farmer may raise potatoes, sufficient at least for home consumption, by following the methods described in this bulletin and epitomized below: (1) Select the best soil; (2) cover with straw in winter; (3) burn just before plowing and plow deep; (4) use seed from higher altitudes; (5) plant very early or very late, 5 inches deep, in rows north and south; (6) stir the surface soil frequently when the plants are small; and (7) irrigate, if needed, in furrows when plants are in blossom, and after they are once wet never allow them to get thoroughly dry until growth ceases.

Sugar beets in Wyoming in 1892, E. E. SLOSSON (*Wyoming Sta. Bul. No. 9, Dec., 1892, pp. 16, plates 2*).—Brief notes on the culture of the crop and tabulated data for analyses of beets grown at the six experiment farms and by farmers in different parts of the State.

The 71 analyses of sugar beets made this year give an average of 16.69 per cent sugar in juice, or 15.85 per cent sugar in beets, with a purity of 78.69. The sample beets, from which these analyses were made, were grown by 18 different farmers, representing all parts of the State. The beets grown in 1891 on the experiment farms averaged 15.79 per cent sugar in juice, with a purity of 78.08. The average of about 140 analyses of Wyoming beets of the seasons of 1891 and 1892 is therefore 16.24 per cent and 78.39 purity. * * *

These results show that rich sugar beets can be grown in many parts of Wyoming. In no crop reported has the per cent of sugar fallen below 12, the lowest marketable rate. The price per ton at which beets could be raised is in most cases less than they would bring at the ordinary factory rates. It appears that the advantages of having the right amount of water at the right time as in irrigation more than compensate for the additional labor of irrigating. Of the two principal varieties, the analyses of the Vilmorin Improved average 16.85 per cent and the Klein Wanzleben 15.98, a difference of almost 1 per cent in favor of the former. The Lane Imperial gives rather poor results.

Tobacco culture, R. J. REDDING (*Georgia Sta. Bul. No. 19, Dec., 1892, pp. 225-238, fig. 1*).—A brief account is given of an experiment at the station in growing tobacco, with a view to determining the adaptability of this crop to the conditions of soil and climate of Georgia. Five acres were planted with Long-Leaf Gooch and Hester varieties. Most of the land used was gravelly loam, with yellow and red clay subsoil. The seed was sown January 21 and February 11 and transplanting was done from May 10 to June 27. Fertilizers were applied per acre as follows: Acid phosphate, 468 pounds; sulphate of potash, 156 pounds; nitrate of soda, 260 pounds. Worms greatly damaged the crop. Harvesting and curing commenced August 15 and was finished October 25. The curing was done by the "leaf-cure" method. The cost of the crop per acre is estimated as follows: Preparing land and seeding, $2.72; fertilizers, $8; transplanting, $3.10; cultivation, $2.25; destroying worms, $10; harvesting and wiring leaves, $6; curing, $4; grading, $6; total, $42.07. The yield per acre was 600 pounds, which would bring $60 at 10 cents a pound, leaving a profit of $17.93. It is

believed that with more experience in the management of the crop better results will be obtained.

Somewhat detailed directions are given for growing, harvesting, and curing tobacco.

Field experiments with wheat, A. J. BONDURANT and J. CLAYTON (*Alabama College Sta. Bul. No. 39, Nov., 1892, pp. 7*).—A report on experiments made with a view to encouraging the growing of wheat in Alabama. In two experiments Purple Straw, Richelle de Naples, and Rieti varieties were planted on quarter-acre plats fertilized with cotton-seed meal, 300 pounds, and acid phosphate, 200 pounds per acre. When the same number of kernels of each variety were sown the yields were nearly alike, but when the same number of pounds of seeds per acre were used the yields varied from 6 to 11 bushels per acre. The cost of growing an acre of wheat was estimated as follows: Breaking land and seeding, $1; seed (1 bushel), $1; fertilizers (500 pounds), $5; harvesting and threshing, $1.50; total, $8.50. The indications were that with Purple Straw, or any equally good variety, 15 bushels of wheat per acre could be obtained in the region of the station in an ordinary season. Tabulated data are given for 15 varieties of winter wheat tested at the station in 1892. The largest yields were Purple Straw, 17; Anglo-Canadian, 16½; Earliest of All, 15, and White Chaff, 13 bushels per acre. Brief reports are given from eight farmers who made experiments with wheat in different parts of the State.

Wheat, fertilizer tests, D. O. NOURSE (*Virginia Sta. Bul. No. 21, Oct., 1892, pp. 95–97*).—Thirty-two half-acre plats of exhausted land were planted with wheat, and manured as follows: Dissolved boneblack, muriate of potash, and nitrate of soda were applied singly and two by two, in full rations or at rates of 142½, 50, and 240 pounds per acre, respectively; and each material in one half rations and one and one half rations with one ration of each of the others. Two plats received gypsum. The yields of the straw and grain are tabulated. The results may be summarized as follows:

The application of nitrogen, potash, or phosphoric acid alone resulted in no increased yield.

The application of two of the elements in combination gave some increase in yield, provided phosphoric acid was in the combination.

Potash increased yield somewhat, provided phosphoric acid was present.

The result with nitrogen was somewhat conflicting, giving some increase with phosphoric acid, but when all three elements were present an increase of nitrogen was of no advantage.

Phosphoric acid each time it was applied (except when alone) gave a decided increase to crop, and the one-and-one-half ration gave the greatest yield.

Plat experiments with commercial fertilizers on wheat, D. D. JOHNSON (*West Virginia Sta. Bul. No. 25, Aug., 1892, pp. 11*).—At four substations in different parts of the State 11 fourth-acre plats were laid out; 2 remained unmanured, and 9 were fertilized as follows, except in a few particulars: (1) Sulphate of potash, 50 pounds per plat; nitrate

of soda, 40 pounds, and dried blood, 40 pounds; (2) muriate of potash, 40 pounds, and ground fish, 60 pounds; (3) muriate of potash, 40 pounds, and dissolved South Carolina rock, 80 pounds; (4) tankage, 100 pounds; dissolved South Carolina rock, 80 pounds, and muriate of potash, 40 pounds; (5) dried blood, 40 pounds, and muriate of potash, 40 pounds; (6) dissolved boneblack, 80 pounds; (7) kainit, 112½ pounds; (8) nitrate of soda, 40 pounds, and (9) stable manure, 8,000 pounds. The yields of grain and straw and the financial returns per acre are tabulated for each experiment. The following conclusions are drawn:

It is not profitable to use nitrogenous fertilizers in large quantities, or use them in ordinary quantities alone as fertilizers for growing wheat.

The combination of potash, nitrogen, and phosphoric acid produces the largest yield.

Phosphoric acid alone produces very satisfactory results.

Probably the most profitable application of commercial fertilizers would be potash, in the form of kainit, and phosphoric acid, in the form of dissolved South Carolina rock.

HORTICULTURE.

A. C. TRUE, *Editor.*

Vegetables and fruits, G. COOTE (*Oregon Sta. Bul. No. 22, Jan., 1893, pp. 24, figs. 7*).—Notes on tests of varieties of strawberries, peas, cabbages, sweet corn, beans, sea kale, gooseberries, currants, blackberries, raspberries, and peaches; an account of an experiment in renovating an old apple orchard; and a list of varieties of apples, pears, cherries, plums, prunes, grapes, crabapples, apricots, nectarines, and almonds planted at the station.

Strawberries (pp. 3–5).—Tabulated data and brief descriptive notes for 28 varieties. During the past four years the most productive varieties were Haverland, Burt, Warfield, Pearl, Glendale, and Henderson.

Peas (pp. 6, 7).—Tabulated data and brief descriptive notes on 25 varieties. New Alaska was the earliest, followed by Daniel O'Rourke, American Wonder, Blue Peter, and Extra Early.

Cabbages, sweet corn, and beans (pp. 7–9).—Tabulated data for 13 varieties of cabbages, 11 of sweet corn, and 27 of beans.

Sea kale (pp. 9, 10).—An illustrated account of an experiment in growing sea kale, which is recommended as a "valuable vegetable, inasmuch as it can be easily forced for use from December to April, provided a succession of plants is at hand for the purpose."

Gooseberries (pp. 10–12).—Brief directions for propagation, pruning, and culture, with brief descriptive notes and tabulated data for 24 varieties.

Currants (pp. 12–15).—Brief illustrated directions for propagation and pruning, with notes on 8 varieties.

Blackberries and raspberries (p. 16).—Notes on 7 varieties of blackberries and 9 of raspberries. Of the latter, Hansell is recommended as an early variety and Cuthbert for the main crop.

The wineberry does not come up to the standard in many ways. The bush is of strong growth, and is very prolific. The fruit is highly colored, but its peculiar flavor is against it. For ornamental purposes it is very attractive.

Apples and peaches (pp. 17–22).—An account of an experiment in renovating an old apple orchard, directions for pruning, and brief notes on the peach orchard planted in 1889 at the station. "Curl leaf" has seriously affected many of the varieties of peaches during the past three years.

Small fruits and grapes, S. B. GREEN (*Minnesota Sta. Bul. No. 25, Dec., 1892, pp. 237–265, fig. 1*).—A report on tests of varieties and some other experiments with small fruits and grapes.

Strawberries (pp. 237–245.)—Tabulated data for 46 varieties and brief descriptive notes on 21 varieties. Haverland and Warfield did especially well. Other desirable varieties were Beder Wood, Crescent, and Michel Early. Captain Jack was very badly affected with rust.

In renewing old strawberry beds the following plan is pursued: As soon as may be after the crop is gathered the bed is closely mowed and all the weeds and strawberry leaves are burned. A plow is then run on each side of a matted row and all but about 1 foot in width of it is turned under. The furrows thus made are filled with fine rotted manure and the cultivator set going. The plants remaining are then thinned out with a hoe and special pains taken to cut out all weeds and old or weak plants. * * *

Many complaints have reached us of the difficulty of securing a good crop of strawberries in exposed places on the prairies, even when the plants had grown well and both staminate and pistillate kinds were planted. This trouble is probably due to the pollen being too much dissipated by the wind, and further to the drying up of the fruit after it is set by the hot sun and winds. With the object of finding a remedy for this trouble some preliminary experiments have been undertaken, in one of which a part of the strawberry bed, including mostly plants of a late variety, named Parker Earle, was shaded with a brush screen, such as we use for protecting evergreen seedlings. The result was that the plants under the screen matured all the fruit, while on those not thus shaded many berries were sun-scalded and many others failed to ripen. * * *

A good screen for this purpose is made by setting posts with natural crotches in one end, connected together by poles and covered with willow or other brush sufficient to give a play of light and shadow on the bed, but not enough to keep out more than half the sunlight.

Raspberries (pp. 245–249).—Descriptive notes and tabulated data for 7 varieties of *Rubus strigosus*, 2 of *R. idæus*, 3 of *R. neglectus*, 14 of *R. occidentalis*, and the Japanese wineberry (*R. japonica*). Cuthbert and Nemaha are especially commended. Other desirable varieties were Brandywine, Golden Queen, Marlboro, Schaffer, Hansell, and Turner. The Japanese wineberry "is interesting to botanists and may be useful for hybridization, but for fruit production is practically worthless."

Blackberries and dewberries (p. 250).—Brief notes on 7 varieties of

blackberries and 2 of dewberries. Ancient Briton, Snyder, and Agawam are especially commended. El Dorado is considered promising. The Lucretia and Windom dewberries have been failures at the station.

Grapes (pp. 251–261).—Tabulated data for 49 varieties and brief descriptive notes on 33 varieties. "The 10 varieties that have given us the most grapes of good table quality in the past five years, arranged nearly in the order of their value, are Concord, Worden, Aminia, Hartford, Brighton, Herbert, Barry, Lindley, Moore Early and Lady. For severe locations the Janesville is very satisfactory on account of its hardiness and reliability, but its quality is very poor."

An account is given of successful experiments in spraying Bordeaux mixture and ammoniacal carbonate of copper for mildew (*Peronospora viticola*).

The following analyses were made by the station chemist:

Sugar and acids in different varieties of grapes.

Name of variety.	Total sugar as grape sugar.	Acid.
	Per cent.	*Per cent.*
Hartford	12.9	1.20
Ives Seedling	12.5	1.24
Lady	9.4	1.22
Herbert	11.5	Lost.
Moore Early	12.6	1.00
Aminia	9.7	1.80
Delaware	15.0	1.20
Catawba*	8.8	2.00
Concord	14.4	1.82
Niagara	10.2	1.16
Lady Washington	14.0	1.74
Martha	14.2	1.52
Eumelan	13.8	1.57
Centennial	16.0	1.42
Brighton	16.6	Lost.
Northern Muscadine	11.4	1.25
Israella	15.4	1.60
Challenge	15.4	1.60

* Analyzed October 17, but not fully ripe.

"The total sugar includes both grape and fruit sugar as determined by Fehling's volumetric method. The results of sugar are calculated in terms of the whole grape and not the juice. The per cent of acid is calculated in terms of the juice as tartaric acid."

Notes on small fruits and grapes at substations (*pp. 262–265*).—Brief notes on trials of a few selected varieties of strawberries, raspberries, blackberries, dewberries, and grapes at Windom, La Crescent, Fergus Falls, Albert Lea, and Minnesota City.

Experiments with orchard fruits, tomatoes, and onions, R. L. WATTS (*Tennessee Sta. Bul., vol. v, No. 4, Nov., 1892, pp. 131–151, plates 3*).—*Orchard fruits* (pp. 131–134).—In 1892 cowpeas planted in the station orchard in May were useful in shading the soil during the summer and in preventing washing of the soil. Brief notes are given on the varieties of apples, pears, peaches, and plums which fruited in 1892.

Tomatoes (pp. 134–147).—An illustrated account is given of an experiment in growing tomatoes under glass in winter. Propagation by cuttings and single-stem training were successfully tried. Artificial pollination was found advantageous. Golden Queen and Lorillard were the most desirable varieties for winter forcing.

Field experiments with tomatoes are also reported. Trimming the plants at intervals of three weeks did not hasten maturity, and decreased the yield. Training to one or two stems increased earliness and improved the size and quality of the fruit. It seems doubtful whether the use of supports for the plants will pay except in training to one or two stems. Plants set in the field May 6 gave larger yields than those set earlier. Plants set at a medium depth gave larger yields than those set at a depth of 2 or 7 inches. Liquid barnyard manure produced no material effect.

Sowing seed in hills and not transplanting did not give good results. One transplanting in flats proved more satisfactory than two transplantings. Seedlings produced a slightly heavier crop than cuttings, but individual fruits from cuttings were much larger.

Old plants which had been carried over the winter produced as heavy a crop as young seedlings. Cutting back to 3 inches at transplanting decreased the yield. Bagging improved the color and quality of fruit and decreased the loss by rot and sun blistering. As regards productiveness, King Humbert and Volunteer were among the first 10 varieties in 1891 and 1892.

Transplanting onions (pp. 147–151).—An experiment in transplanting onions according to the method proposed by T. Greiner was successfully made at the station. The transplanted plants matured earlier, the bulbs averaged much larger, and the yield was quadrupled.

Fruit culture in Arkansas Valley, F. L. WATROUS (*Colorado Sta. Bul. No. 21, Oct., 1892, pp. 12–15*).—Brief directions for the culture of orchard fruits in this region and tabulated notes on varieties of apples, pears, plums, and grapes growing at the substation.

Notes on forest and fruit trees, E. S. RICHMAN (*Utah Bul. No. 18, Oct., 1892, pp. 11*).—Brief notes on the growth of 41 species of forest trees planted at the station, and on 88 varieties of apples, 35 of pears, 25 of plums, 27 of cherries, 35 of peaches, and 5 of apricots.

Herbaceous ornamental plants for Minnesota, S. B. GREEN (*Minnesota Sta. Bul. No. 24, Oct., 1892, pp. 209–213 and 223, 224*).—Brief descriptive notes and tabulated data regarding hardiness for the following species: Yarrow*† (*Achillea millefolium* var. *rosea*), double white yarrow† (*A. ptarmica*), columbine† (*Aquilegia vulgaris*), hollyhock (*Althea rosea*), reed (*Arundo donax*), variegated reed (*A. donax*, var. *versicolor*), milkweeds*† (*Asclepias incarnata* and *A. tuberosa*), hardy asters*† (*Aster* spp.), bocconia (*Bocconia cordata*), lily of the valley† (*Convallaria majalis*), coreopsis† (*Coreopsis lanceolata*), larkspur† (*Delphinium* spp.), bleeding heart† (*Dicentra spectabilis*), gas plant (*Dictam-*

* Native in Minnesota. † Hardy at the station.

nus fraxinella), pampas grass (*Erianthus ravennæ*), eulalia (*Eulalia japonica*, vars. *zebrina*, *variegata*, and *gracillima*), funkia (*Funkia cærulea*), baby's breath† (*Gypsophila paniculata*), perennial double sunflower (*Helianthus multiflorus*), fleur de lis† (*Iris germanica*), poker plant (*Kniphofia aloides*), peonies† (*Pæonia* spp.), mountain fleece† (*Polygonum cuspidatum*), phlox† (*Phlox decussata*), ribbon grass† (*Phalaris arundinacea*), pyrethrum† (*Pyrethrum roseum*), meadow sweet† (*Spirea japonica*), tansy† (*Tanacetum balsamita*), spider wort*† (*Tradescantia virginica*), pansy (*Viola tricolor*), Adam's needle (*Yucca filamentosa*).

The following select list is given of species most desirable for planting in the region of the station: Columbine, lily of the valley, larkspur, bleeding heart, baby's breath, German iris, pyrethrum, herbaceous peonies, and double yarrow.

FORESTRY.

Ornamental and timber trees, shrubs, and vines, S. B. GREEN (*Minnesota Sta. Bul. No. 24, Oct., 1892, pp. 173–208, and 214–222*).—Brief descriptive notes and tabulated data regarding hardiness for the following species of native and imported trees, shrubs, and vines, with reference to their usefulness for timber or for planting in parks, streets, or lawns in Minnesota, as determined by tests made at the station and by the experience of planters and nurserymen in Minnesota and neighboring States: White or soft maple*† (*Acer dasycarpum*), cut-leafed maple† (*A. dasycarpum*, var. *wierii*), sugar maple*† (*A. saccharinum*), Norway maple (*A. platanoides*), Schwedler maple (*A. platanoides*, var. *schwedlerii*), Rittenbach maple (*A. platanoides*, var. *rittenbachii*), red maple*† (*A. rubrum*), Tartarian maple (*A. tartaricum*), horse chestnut (*Æsculus hippocastanum*), buckeye chestnut* (*Æ. glabra*), tree of heaven (*Ailanthus glandulosus*), European alder*† (*Alnus incana*), European birch† (*Betula alba*), cut-leafed birch† (*B. alba*, var. *laciniata*), purple birch† (*B. alba*, var. *atropurpurea*), canoe or paper birch*† (*B. papyrifera*), yellow birch*† (*B. lutea*), American white birch*† (*B. alba*, var. *populifolia*), laburnum (*Cytisus laburnum*), American hornbeam*† (*Carpinus americana*), bitternut hickory*† (*Carya amara*), chestnut (*Castanea americana*), hardy catalpa (*Catalpa speciosa*), hackberry or nettle tree* (*Celtis occidentalis*), white fringe (*Chionanthus virginica*), cockspur thorn or thorn apple*† (*Cratægus crus-galli*), American beech (*Fagus ferruginea*), European beech (*F. sylvatica*), white ash*† (*Fraxinus americana*), green ash*† (*F. viridis*), honey locust* (*Gleditschia triacanthos*), Kentucky coffee tree*† (*Gymnocladus canadensis*), black walnut* (*Juglans nigra*), butternut*† (*J. cinerea*), European larch† (*Larix europea*), tamarack*† (*L. americana*), tulip poplar or white wood (*Liriodendron tulipifera*), osage orange (*Maclura aurantiaca*),

* Native in Minnesota. † Hardy at the station.

magnolia (*Magnolia* spp), Russian mulberry† (*Morus alba*, var. *tatarica*), box elder*† (*Negundo aceroides*), ironwood*† (*Ostrya virginica*), white or silver poplar† (*Populus alba*), bolleana poplar† (*P. alba*, var. *nivea*), Lombardy poplar (*P. fastigiata*), Russian poplar† (*P. wobsky*), Russian poplar† (*P. certinensis*), Russian poplar† (*P. siberica*, var. *pyramidalis*), birch-leafed poplar† (*P. betulifolia*), Russian poplar† (*P. laurifolia*), cottonwood*† (*P. monilifera*), golden poplar† (*P. monilifera*, var. *van-gertii*), black cherry*† (*Prunus serotina*), choke cherry*† (*P. virginica*), bird cherry*† (*P. pennsylvanica*), European or mountain ash† (*Pyrus aucuparia*), native crab apple*† (*P. coronaria*), weeping mountain ash† (*P. aucuparia*, var. *pendula*), American mountain ash*† (*P. americana*), burr oak*† (*Quercus macrocarpa*), white oak*† (*Q. alba*), red oak*† (*Q. rubra*), scarlet oak*† (*Q. coccinea*), black or yellow locust (*Robinia pseudacacia*), maiden-hair tree or gingko (*Salisburia adiantifolia*), Russian willow† (*Salix acutifolia*), laurel-leafed willow† (*S. laurifolia*), American weeping or fountain willow (*S. purpurea*, var. *pendula*), royal willow (*S. regalis*), Kilmarnock weeping willow (*S. caprea*, var. *pendula*), Russian golden willow† (*S. aurea*), Napoleon's willow† (*S. napoleonis*), Wisconsin weeping willow,† white willow† (*S. alba*), basswood or American linden*† (*Tilia americana*), European linden (*T. europea*), American or white elm*† (*Ulmus americana*), red or slippery elm*† (*U. fulva*), weeping slippery elm† (*U. fulva*, var. *pendula*), rock elm*† (*U. racemosa*), camperdown weeping elm (*U. montana*, var. *camperdownii*), aralia or angelica tree† (*Aralia mandshurica*), azalea (*Azalea* spp.), althea or Rose of Sharon (*Hibiscus syriacus*), box (*Buxus* spp.), common or European barberry† (*Berberis vulgaris*), purple-leafed barberry (*B. vulgaris*, var. *purpurea*), Thunberg's barberry† (*B. thunbergii*), strawberry shrub (*Calycanthus floridus*), sweet pepper bush (*Clethra alnifolia*), Siberian pea tree† (*Caragana arborescens*), red-twigged dogwood† (*Cornus sanguinea*), red-twigged dogwood*† (*Cornus stolonifera*), deutzia (*Deutzia crenata*), deutzia (*D. gracilis*), weigela (*Diervilla rosea*), spindle tree*† (*Euonymus atropurpureus*), forsythia (*Forsythia fortuneii*), hardy hydrangea (*Hydrangea paniculata*, var. *grandiflora*), St. John's wort (*Hypericum aureum*, *H. kalmianum*,† and *H. salicifolia*), balsam fir or balsam*† (*Abies balsamea*), Nordmans fir (*A. nordmanniana*), red cedar*† (*Juniperus virginiana*), trailing or savin juniper*† (*J. sabina*), Norway spruce† (*Picea excelsa*), white spruce*† (*P. alba*), Colorado blue spruce† (*P. pungens*), black spruce* (*P. nigra*), Engleman's spruce (*P. engelmanii*), white pine† (*Pinus strobus*), Scotch pine† (*P. sylvatica*), Austrian pine† (*P. austriaca*), red or Norway pine*† (*P. resinosa*), dwarf pine† (*P. mughus*), heavy-wooded pine† (*P. ponderosa*), Douglas spruce† (*Pseudotsuga taxifolia*), Japan cedar (*Retinospora plumosa*), arbor vitæ or white cedar*† (*Thuja occidentalis*), hemlock*† (*Tsuga canadensis*), mountain laurel (*Kalmia latifolia*), Polish privet (*Ligustrum vulgare*), California privet (*L. ovalifolium*), privet† (*L.* from Poland), Tartarian honeysuckle† (*Lonicera tartarica* and *L. tartarica*, var. *splendens*), syringa or mock

* Native in Minnesota. † Hardy at the station.

orange† (*Philadelphus coronarius*), syringa or mock orange† (*P. grandiflorus*), syringa or mock orange† (*P. gordonianus*), flowering almond (*Prunus japonica*), nine bark*† (*Physocarpus opulifolius*), golden spirea† (*P. opulifolius*, var. *aurea*), shrubby cinquefoil*† (*Potentilla fruticosa*), trefoil or hop tree* (*Ptelea trifoliata*), Japan quince (*Pyrus japonica*), common buckthorn† (*Rhamnus catharticus*), common smooth-leafed sumach*† (*Rhus glabra*), cut-leafed sumach† (*R. glabra*, var. *laciniata*), smoke bush (*R. cotinus*), staghorn sumach*† (*R. typhina*), rhododendron (*Rhododendron*, spp.), yellow flowering currant† (*Ribes aureum*), Alpine currant† (*R. alpinum*), Gordon currant (*R. gordonianum*), common elder*† (*Sambucus canadensis*), red-berried elder*† (*S. racemosa*), cut-leafed elder† (*S. nigra*, var. *aurea*), buffalo berry*† (*Shepherdia argentea*), Van Houtte's spirea† (*Spirea van houtti*), *S. obovata*†, Douglas spirea† (*S. douglasii*), *S. lanceolata*,† plum-leafed spirea† (*S. prunifolia*), Thunberg's spirea (*S. thunbergii*), ash-leafed spirea† (*S. sorbifolia*), hypericum-leafed spirea† (*S. hypericifolia*), snowberry*† (*Symphoricarpus racemosus*), common lilac† (*Syringa vulgaris*), Persian lilac† (*S. persica*), Josikas lilac† (*S. josikæa*), high-bush cranberry*† (*Viburnum opulus*), snowball† (*V. opulus*, var. *sterilis*), sheepberry*† (*V. lentago*), arrow wood*† (*V. dentatum*), prickly ash*† (*Zanthoxylum americana*), Japanese ivy (*Akebia quinata*), Virginia creeper*† (*Ampelopsis quinquefolia*), Japanese or Boston ivy (*A. veitchii*), Dutchman's pipe* (*Aristolochia sipho*), bittersweet*† (*Celastrus scandens*), European sweet clematis (*Clematis flammula*), *C. jackmanni*, *C. coccinea*, virgin's bower*† (*C. virginiana*), *C. viticelli*,† honeysuckle*† (*Lonicera sullivanti*), moonseed*† (*Menispermum canadense*), wistaria (*Wistaria* spp.), and wild grape*† (*Vitis riparia*).

The following select list is given of species most desirable for planting in the region of the station: American elm, hackberry, basswood, soft maple, box elder, white ash, white willow, paper birch, cut-leaved weeping birch, upright white poplar, European mountain ash, laurel-leaved willow, oil berry, white pine, red pine, Scotch pine, dwarf pine, white spruce, Norway spruce, red cedar, red-twigged dogwood, hardy hydrangea, Tartarian honeysuckle, syringa, golden spirea, buckthorn, Japanese rose, Missouri currant, Van Houtte's spirea, ash-leaved spirea, *Spirea obovata*, buffalo berry, lilac, high-bush cranberry, snowball, Virginia creeper, bitter sweet, virgin's bower, and wild grape.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor*.

Some fungous diseases of the quince fruit, B. D. HALSTED (*New Jersey Stas. Bul. No. 91, Dec. 14, 1892, pp. 16, figs. 12*).—A report upon the following diseases of the fruit of the quince observed during the past season: Quince rust (*Ræstelia aurantiaca*), fruit spot (*Entomosporium maculatum*), black rot of quince (*Sphæropsis malorum*), pale

*Native in Minnesota. † Hardy at the station.

spot of quince (*Phoma cydoniæ*), ripe rot of quince (*Glœosporium fructigenum*), quince blotch, and other minor decays.

The first fungus to make its appearance upon the quince fruit in early summer is the rust. While the fruit is quite small the fine threads of the rust plant grow through it, and in one or more places the green color is replaced by an orange color, the quince at the same time usually becoming distorted. In the orange patches small pimples appear which continue to enlarge and from them short horns project and soon become ruptured at the top. Within these horns or tubes the bright orange spores are borne in great abundance and readily fall out. As time passes the affected fruit, failing to grow, or enlarging but slowly, becomes hard by drying and either falls to the ground or remains on the tree as a worthless and unsightly product until the close of the season.

The rust of quinces is a form of one of the cedar apples. This species (*Gymnosporangium clavipes*) is found on two kinds of juniper trees, the red cedar and low juniper, and may be recognized by the swollen knots of reddish color. Fungicides unless applied at the proper season will prove of no avail. Removing all cedar trees will prove more effective.

Quince fruit spot is caused by the fungus *Entomosporium maculatum;* it is also found on the leaves of the quince as reported in the Annual Reports of the Connecticut State Station for 1890 and 1891 (E. S. R., vol. III, pp. 10 and 770), and upon fruit and leaves of apple and pear. Its attack is superficial on the quince, and the result is a smaller and unsightly product.

Black rot of the quince, one of the most abundant and, therefore, destructive decays of this fruit made its appearance upon the fruit when less than half grown. Almost invariably the first signs of the rot were found at the blossom end, and from there it rapidly extends throughout the whole fruit. At first the skin, losing its normal color, turns a light brown, and shortly after this dark pimples appear scattered beneath the skin, which is ruptured when the spores are matured. The ripe spores are olive brown, about twice as long as broad, and form long, slender coils as they are pushed out of the small hole in the skin.

The spores quickly germinate, and the author made a study of the apple and pear along with the quince in inoculating from one kind of fruit to the other. He concludes that what have hitherto been considered three species are all the same. Field observation showed that the disease will easily spread from one kind of tree to the other, and that fallen fruit may possibly spread the infection if left to rot on the ground. If spraying is employed all three kinds of trees should be treated.

Pale rot of quince is caused by a fungus which the author thinks identical with *Phoma cydoniæ* of Europe. Next to black rot it was the most prevalent disease. It is a rapidly growing fungus, running through a fruit in a few days.

It begins at any place upon the fruit, producing at first a pale spot, from which the skin may be easily removed. The threads of the fungus soften the flesh of the quince more than the black rot, and the skin soon wrinkles, and at the same time is ruptured in many places, from which short tufts of threads develop. These small spots, usually circular in outline, are at first colorless, but soon turn to a handsome shade of pale blue. As the days pass there is a spore cavity formed below the surface of each spot, and from this the spores issue in a thread of slime through the ruptured center of the spot.

The ripe rot of quinces is caused by the fungus which also causes the bitter rot of apples and the ripe rot of grapes, as reported in Journal of Mycology, vol. VI, No. 4 (E. S. R., vol. II, p. 749). The author has transferred the disease by inoculations between the apple and quince.

Quince blotch is an obscure disease, retarding the growth of the fruit. The fungus has been isolated and upon agar-agar produces similar blotches to those on the quince. The fungus is of slow growth and quite different from any heretofore noticed upon this fruit.

Other fungi causing decay of quinces are reported as follows: *Rhizopus nigricans*, the same as the one causing soft rot of sweet potatoes described in Bulletin No. 76 of the New Jersey Stations (E. S. R., vol. II, p. 416). It can only attack the fruit after the skin has been broken.

Gray mold is similar to the black mold. It is caused by *Monilia fructigena*, the fungus of a common disease of the plum and cherry. Its attacks are usually made on the stored fruit if wet and unventilated. There is another black rot (*Pestalozzia* sp.) sometimes met with in quinces which causes the fruit to become coal black.

The author has experimented with fungicides to prevent the foregoing diseases with considerable success. Bordeaux mixture (standard formula) and ammoniacal solution of copper carbonate by the following formula gave the best results: Copper carbonate, 5 ounces; ammonia, 26°, 3 quarts; water, 50 gallons. He advises using the Bordeaux mixture the first half of the season, to be followed by copper carbonate solution or Bordeaux mixture diluted one half. Spraying should begin as soon as the buds begin to swell, and be continued until September with weekly applications.

Black rot of grapes, R. H. PRICE (*Texas Sta. Bul. No. 23, Nov. 1892, pp. 219–231, figs. 10*).—The author describes and figures the various phases of the fungus causing the black rot of grapes. He also describes at some length and figures "dark threadlike articulated bodies found occurring with the asci in specimens grown in the greenhouse." These he thinks are paraphyses, but Prof. B. T. Galloway, to whom they were submitted, thinks they are not. On the presumption that these bodies are really paraphyses the author would transfer this fungus back to the genus *Physalospora*. Compiled information is given regarding the preparation and use of fungicides for the black rot, as well as for other diseases of the grape. Spraying apparatus is briefly described and prices given.

Common fungous diseases and their treatment, W. C. STURGIS (*Connecticut State Sta. Bul. No. 115, Mar., 1893, pp. 21*).—Popular descriptions of the following diseases are given with suggestions as to preventive treatment: Apple scab (*Fusicladium dendriticum*), leaf blight or leaf spot of pear (*Entomosporium maculatum*), pear scab (*Fusicladium pyrinum*), leaf blight or leaf spot of quince (*Entomosporium maculatum*), black rot of quince (*Sphæropsis malorum*), peach yellows, black knot of plum and cherry (*Plowrightia morbosa*), brown rot of plum and cherry (*Monilia fructigena*), black rot of grape (*Læstadia bidwellii*),

brown rot or downy mildew of grape (*Plasmopara viticola*), anthracnose of grape (*Sphaceloma ampelinum*), anthracnose of raspberry and blackberry (*Glœosporium necator*), leaf blight of strawberry (*Sphærella fragariæ*), smut of onions (*Urocystis cepulæ*), potato rot (*Phytophthora infestans*), tomato leaf blight (*Cladosporium fulvum*), and celery leaf blight (*Cercospora apii*). Two formulas for Bordeaux mixture, and one each for ammoniacal carbonate of copper and modified eau celeste are given, with the cost of the chemicals. Spraying apparatus is described and prices given. Most of the bulletin is a reprint of Bulletin No. 111 of the station (E. S. R., vol. III, p. 846).

A provisional spraying calender is given, showing when to treat the various plant diseases.

Bordeaux mixture for apple pests, H. GARMAN (*Kentucky Sta. Bul. No. 41, Jan., 1893, pp. 32, figs. 2*).—The primary object of the series of experiments reported in this bulletin was to study the effect of Bordeaux mixture on apple rot (*Glœosporium versicolor*). A brief popular description is given of the disease and its cause. The author considers the presence of mummified apples on the tree to be the chief source of infection to the growing crop. Cultures of spores obtained from the dried remains of decayed apples were made in gelatine and also in apples, and the fungi thus produced were found to be identical with those occurring in the ordinary course of infection. Trees from which all mummified apples were removed were more thrifty and yielded more fruit than those on which they were permitted to remain.

Three series of experiments were conducted in each case with one treated and one untreated tree. In the first series two trees of a fall variety were sprayed for the codling moth the middle of May, after which one of them received no further treatment. From the other all the mummified apples were removed and Bordeaux mixture was applied May 23, June 6, and July 6. In the second series Ben Davis apple trees were used, but the preliminary treatment was omitted and the mummified apples were not removed. In the third series Russet apple trees of comparatively large size were selected and the apples were not harvested until September 30, when nearly all had fallen from both trees. The formula used for the Bordeaux mixture was: Copper sulphate, $6\frac{1}{2}$ pounds; lime, $3\frac{1}{2}$ pounds; water, 22 gallons.

The tabulated results are as follows:

Results of spraying apple trees with Bordeaux mixture for rot.

Series.		Fallen apples.			Picked apples.			Whole crop of apples.		
		Total number.	Number rotten.	Per cent rotten.	Total number.	Number with rot.	Per cent with rot.	Total number.	Number with rot.	Per cent with rot.
I	Treated tree	488	183	37.5	1,467	175	12.0	1,955	358	18.3
	Untreated tree	395	215	54.4	748	352	47.0	1,143	561	49.5
II	Treated tree	562	192	35.2	655	11	1.7	1,217	209	17.2
	Untreated tree	1,181	594	50.0	213	54	25.4	1,394	648	39.3
III	Treated tree	1,522	593	39.0	164	41	24.5	1,686	634	37.6
	Untreated tree	1,100	520	47.3	172	57	33.1	1,272	577	45.4

In these experiments treatment with Bordeaux mixture improved the condition of the foliage and caused the leaves to be retained longer on the trees. When the fungicide was applied early the total and the merchantable crop of apples was increased, the proportion of rotten apples was decreased, and the apples were retained longer on the trees.

Apple scab did not appear on either of the trees used in the third series of experiments, but in the second series 12.1 per cent of the apples on the treated tree were scabby, and 65.9 per cent of those on the untreated tree. In another experiment not included in the series mentioned above, Bordeaux mixture applied May 23 and June 6 materially reduced the amount of scab as compared with that on an untreated tree near by.

The author also considers the relation between the codling moth (*Carpocapsa pomonella*) and apple rot. He finds that the codling moth is worse upon the sprayed trees almost in proportion to the decrease of the rot. This is due, he thinks, to the avoidance of apples affected by rot when the female is laying her eggs. This hypothesis would not hold good for the earliest brood of the codling moth, but would for the second, which in the region of the station is the more important and destructive brood. He found no difference between the sprayed and check trees for the first brood.

ENTOMOLOGY.

Notes on a corn crambid, M. H. BECKWITH (*Delaware Sta. Bul. No. 14, Dec., 1891, pp. 13–15, fig. 1*).—June 15, 1891, it was reported that worms were destroying corn plants at Dover, Delaware. The resulting investigation led to the discovery that a corn crambid was the cause of the injury.

This crambid does not penetrate the plant and remain feeding upon the tender inner parts, but works upon the outer portion just beneath the surface of the soil. It spins silken galleries, which extend from the plant several inches just beneath the surface of the soil. Some plants were nearly girdled, and the worms were frequently found embedded in cavities where they had fed upon the plants. In some instances as many as 30 worms were found in a single hill of corn. In many hills the plants had been entirely destroyed; in others they were small and had a yellow, sickly appearance. The greatest injury appeared to have been caused in that portion of the cornfield adjoining a small strip of timothy sod that remained without plowing.

This worm feeding upon the plants beneath the surface of the soil renders it impossible to treat the plants with an insecticide with any hope of destroying the insects. Further study of the life history of this insect is necessary before a remedy can be recommended.

July 16 the adult insect began to appear in a breeding cage where a number of larvæ had been placed. The insect was identified at this Department as *Crambus caliginosellus*, which had been observed at Bennings, Maryland, in 1886. Illustrations of the larva and imago are given in the bulletin, together with the following description:

The moth or perfect insect averages ½ an inch in length and measures about 1 inch across its expanded wings. The body is slender; its front wings are of an ashy-gray

color, marked with rows of brownish scales between the veins and two transverse rows of brownish scales on the outer portion of the wing, the other third of which is also of a darker color than the remainder of the wing. The fringe of the wing is of the same ash-gray color as the wing itself, and there is a row of black scales along the apical margin of the wing. The hind wings are a darker color than the front wings. The thorax, abdomen, and legs are the same color as the wings. Two long scaly palpi project from the front of the head like a proboscis or beak.

A peculiarity of this insect that is very noticeable is that when at rest the wings and body are elevated at an angle with the substance on which it rests.

The larva or caterpillar is about 1 inch in length when fully grown and of a slender, cylindrical form, and of a pinkish-white color slightly tinged with brown. The head is dark brown or black. There are several stiff bristles or hairs upon each segment.

Report on insects, C. H. FERNALD (*Massachusetts Hatch Sta. Bul. No. 20, Jan., 1893, pp. 16, figs. 13*).—Illustrated accounts of the following injurious insects, with suggestions regarding remedies: Spring cankerworm (*Paleacrita vernata*), fall cankerworm (*Anisopterix pometaria*), apple tree tent caterpillar (*Clisiocampa americana*,) fall webworm (*Hyphantria cunea*), white-marked tussock moth (*Orgyia leucostigma*), willow tussock moth (*O. definita*), and the European tussock moth (*O. antiqua*).

Inspection of Paris green (*Louisiana Stas. Bul. No. 18, 2d ser., pp. 529–532*).—The text of the State law regulating the trade in Paris green, with notes on the quality of the product sold in the State and a description of the method of analysis used at the station.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor*.

On fodder articles and fodder supplies, C. A. GOESSMANN (*Massachusetts State Sta. Bul. No. 45, Nov., 1892, pp. 15*).—In this article the author strongly advocates the raising of a greater variety of crops for stock-feeding and especially more leguminous crops to take the place of more expensive commercial feeding stuffs; and he urges that in selecting crops to be grown or feeds to be bought, the question of their manurial value should be considered. He shows, for instance, that while corn meal, costing $24 per ton, has a manurial value of only $7.31 per ton, Chicago gluten meal, cotton-seed meal, and linseed meal (old process), costing from $26 to $28 per ton, have a manurial value ranging from $14.72 to $23.52 per ton.

During the past year (1892) the station tested the following forage plants: Summer vetch, soja beans, Bokhara clover, sainfoin, horse beans, cowpeas, yellow trefoil, serradella, prickly comfrey, flat pea (*Lathyrus sylvestris*), kidney vetch, blue lupine, yellow lupine, silver-hull buckwheat, Japanese buckwheat, common buckwheat, summer rape, winter rape, Jerusalem artichoke, and sugar beets. The detailed report of these trials is reserved for the annual report. A summary of the yield of

some of these plants grown on a large scale is given in a table and compared with hay and rowen, as follows:

Yield of various forage crops per acre.

Crop.	Yield per acre.	Dry matter per acre.	Nitrogen per acre.
	Tons.	*Pounds.*	*Pounds.*
Fodder corn (kernels glazing)	18	11,329	116
Serradella	12	4,313	104
Vetch and oats	8.05	2,894	78
Soja beans	11.1	5,949	71
Hay	2	3,509	58
Rye	7	4,406	37
Peas and oats	5	1,368	36
Rowen	1	1,795	36
Hungarian grass	2.5	1,285	18

"Rye, vetch and oats, peas and oats, part of soja beans, of corn, and of serradella have been fed as green fodder, and the remainder of green corn and soja beans, serradella, and Hungarian grass are on hand in silos as mixed silage for winter use."

The yield of hay and rowen (3 tons per acre) is believed to be far in excess of the average for the State, which "does not much exceed 1 ton of hay per acre."

A table is given which embodies the maximum and minimum percentages of dry matter, protein, and fat found in the analyses, made at the station, of a large number of commercial feeding stuffs. This shows the wide variations in the composition of these materials, especially by-products from factories, at different times, and indicates the desirability of State control of the sale of feeding stuffs.

"The money invested by farmers for securing commercial feeding stuffs as an additional food supply for home consumption exceeds to-day many times the amount spent for commercial fertilizers. * * * The generally conceded success of the introduction of a well-regulated system of State inspection of commercial fertilizers seems to suggest the adoption of a similar course with reference to the trade in commercial feeding stuffs."

Effect of food on composition of butter fat, F. W. MORSE (*New Hampshire Sta. Bul. No. 16, Sept. 1892, pp. 20*).

Synopsis.—An account of experiments with twelve cows to test the effects of corn meal, gluten meal, cotton-seed meal, cotton seed, wheat gluten, corn starch, mixed hay, oat hay, clover hay, vetch hay, pasture grass, cotton-seed oil, palm oil, corn oil, cocoanut oil, stearin, and olein, respectively, on the volatile fatty acids and the iodine number of the butter. The analyses of the feeding stuffs and butter are tabulated. The results indicate that certain of the materials mentioned do affect the volatile fatty acids and the iodine number of the butter and suggest a connection between the fat of the food and the fat of the milk.

Effect of common feeding stuffs.—Two series of experiments are described—one to study the effect of grain feeds, and the other of different kinds of hay.

In the first series of trials eight cows (four lots of two each) were used. The coarse fodder (hay, grass, and silage) remained constant until the last period, when pasturage was given in its stead. Corn meal was compared with cotton-seed meal and with gluten meal, and the effect observed of adding about a pound of wheat gluten to the daily ration. The trials continued through June and July. Samples of butter were taken for analysis at frequent intervals. The results of the trials are summarized as follows: "Corn meal had no effect on the volatile acids, but lowered the iodine number; gluten meal affected the volatile acids only after they had been depressed by some other food, when it raised them, while the iodine number was raised in every case; cotton-seed meal lowered both volatile acids and iodine number. Grass did not, in general, affect the composition of the butter, which fact corresponds with recent German investigations."

Part of the cows were dropped during the trial, but "in the case of the four cows continuing through the experiment the volatile acids decreased and the iodine number increased as the period of lactation advanced," agreeing in this respect with the observations of others.

In the second series seven cows were used (four lots), three of which were used in the first series. Here the grain ration (middlings, gluten meal, and cotton-seed meal) and silage remained constant, and mixed hay was compared with oat hay, clover hay, and vetch hay, respectively. Neither vetch nor oat hay produced any apparent change in the volatile fatty acids. Clover hay appeared to increase the volatile fatty acids, and mixed hay sustained this increase.

The sinking of volatile acids and rising of the iodine number with the advance of lactation was again seen in this series. Some of the results of this scientific investigation are in accord with the practice of many dairymen who produce a high grade of butter. A favorite ration with them is corn meal and clover or mixed hay.

Corn meal has been shown to produce a butter fat with a low iodine number, corresponding to a hard, firm butter. Clover hay and mixed hay have produced a butter fat with a high figure for volatile acids, which is equivalent to a high flavor.

Nevertheless, corn meal and clover hay are not the only suitable foods for producing a firm, highly flavored butter, and the study of this bulletin should show other combinations even better.

Effect of various oils, etc.—In the first series of trials, with the same cows used in previous trials, the effect was tried of adding cotton seed, cotton-seed oil, and starch, respectively, to gluten meal. Gluten meal, cotton seed, and cotton-seed meal were also fed singly. A constant ration of silage, hay, and middlings was fed in addition to the grain. The iodine number decreased in the case of the two lots receiving cotton seed or cotton-seed meal, while the volatile fatty acids decreased with one lot on either of these feeding stuffs, and with the other decreased on cotton seed and increased on cotton-seed meal. "Comparing the rate of change in both constituents, for each substance, cotton seed influenced the composition of the butter more than the cotton-seed meal."

When cotton-seed oil (13.5 oz. per 1,000 pounds live weight per day) was fed with gluten meal "there was a decided lowering of the volatile acids, which was apparently due to the oil, but the iodine number was not changed much."

Corn starch (3.4 pounds per 1,000 pounds live weight) fed with gluten meal "produced the same effect as corn meal, decreasing the iodine number and causing no variation in the volatile acids."

In a continuation of these experiments 3 cows, used in previous trials, were fed a constant basal ration, to which was added, in separate periods, 11 oz. each of palm oil, corn oil, cotton-seed oil, cocoanut oil, commercial stearin, and olein. The basal ration consisted of silage, clover or vetch hay, oatmeal, and middlings.

As the result of these trials, it was shown that the volatile acids were only slightly affected, but on the whole were decreased by feeding fats. A comparison of the changes in the butter fat with the volatile acids of the fats used in the rations showed a striking result, and the comparison is here given:

Oil fed.	Volatile acids of oil fed.	Change in volatile acids of butter.	
Cocoanut	6.5	30.7 to 29.8	—0.9
Corn	3.2	29.0 to 28.4	—0.6
Cotton-seed	1.1	31.3 to 25.2	—6.1
Palm	1.7	33.1 to 31.5	—1.6
Olein	2.0	27.6 to 30.7	+3.1
Stearin	1.4	31.5 to 28.0	—3.5

With the exception of the olein, which increased the volatile acids over the previous ration, the fats caused the volatile acids of the butter to vary in the order of their own contents of volatile acids.

The iodine number was more affected by feeding the fats, and here again was a striking coincidence, which is shown in the following comparison of the oils and their action:

Oil fed.	Iodine number of oil fed.	Change in iodine number of butter.	
Corn	112.8	28.4 to 38.1	+9.7
Cottonseed	106.1	33.5 to 41.9	+8.4
Palm	52.2	33.0 to 34.8	+1.8
Cocoanut	7.1	31.6 to 21.2	—7.4
Olein	47.5	32.3 to 31.6	—0.7
Stearin	24.1	34.8 to 35.6	+0.8

In this comparison it is shown that with the exception of the olein the fats caused the iodine number in the butter to vary in accordance with their own iodine numbers.

Summary of results.—The results agree with those of previous studies reported in Bulletin No. 13 of the station (E. S. R., vol. III, p. 86) in showing that gluten meal raised the iodine number of the butter fat in every case—that is, gave a softer butter than corn meal or cotton-seed meal.

It was found that, of the constituents of corn meal, the gluten or albuminoids had the property of affecting the volatile acids in the butter fat, while the starch and oil affected the iodine number, the former decreasing and the latter increasing it.

Since gluten meal contained both oil and albuminoids, and the oil affected the iodine number as much as the gluten meal did, it was impossible to say that the albuminoids did or did not act on it.

Of the cotton-seed constituents, it was found that the oil and the meal, or nitrogenous part, affected the volatile acids alike; but the iodine number was raised by the oil and lowered by the meal.

When fed altogether in the original grain, cotton seed produced the effect of the meal or nitrogenous matter; while corn produced the effect of the starch.

These trials with carbohydrates, albuminoids, and fats were not numerous enough to enable one to formulate a new theory from them or to overthrow old theories; but they do not agree with the theory that milk fat is formed from the albuminoids only of the food constituents, and that fats in the food do not enter into the fat of of the milk.

Stock feeders' guide, G. H. WHITCHER (*New Hampshire Sta. Bul. No. 17, Oct., 1892, pp. 14, fig. 1*).—This is a popular bulletin for farmers, on the application of feeding standards in practice, and is accompanied by a chart for use in the barn. It contains tables giving German feeding standards, the composition of a large number of feeding stuffs, standard grain mixtures, and 12 standard rations for cows per 1,000 pounds live weight. The method of calculating rations is explained in the bulletin and the chart.

A reprint from bulletin No. 4 of the station, describing the construction of a home-made balance for weighing coarse fodder, is given in an appendix.

STATION STATISTICS.

Fourth Annual Report of Alabama College Station (*Alabama College Sta. Report for 1891, pp. 19*).—This includes the reports of the treasurer (for the fiscal year ending June 30, 1891), chemist, botanist, biologist, and agriculturist, which contain brief outline statements regarding the work of the station. The number of analyses made in the chemical laboratory during 1891 was 446, and included fertilizers, feeding stuffs, milk, butter, and miscellaneous substances. A botanical survey of the State is in progress. Studies on woods and weeds have been made. A list of articles published during the year in different journals by the biologist, G. F. Atkinson, is given.

Fourth and Fifth Annual Reports of Indiana Station (*Indiana Sta. Reports for 1891 and 1892, pp. 30 and 25*).—These include the reports of the director, agriculturist, veterinarian, chemist, horticulturist, and botanist, which contain an outline of the work of the station during 1891 and 1892. There are also financial statements for the fiscal years ending June 30, 1891 and 1892.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Insect Life (*Division of Entomology, Insect Life, vol. v, No. 2, Nov., 1892, pp. 63–146, fig. 3.*)—The larger part of this number is devoted to the proceedings of the fourth annual meeting of the Association of Economic Entomologists, which was held at Rochester, New York, August 15 and 16, 1892. The following are the special articles incorporated in the minutes:

Address of the first vice-president, S. A. Forbes (pp. 68–76).—A summary of the principal work of the year in economic entomology.

Hypoderas columbæ, D. S. Kellicott (pp. 77–78).—Description with figure of this interesting mite which was found in the thymus of a domestic pigeon at the Ohio State University.

The possible and actual influence of irrigation on insect injury in New Mexico, C. H. T. Townsend (pp. 78–81).—A discussion of the importance of irrigation in New Mexico and its possible effects upon the vine leaf hopper (*Typhlocyba vitifex*), codling moth (*Carpocapsa pomonella*), peach-tree borer (*Sannina exitiosa*), green June beetle (*Allorhina mutabilis*), and a number of other insects.

Notes on Ægeriidæ of central Ohio, D. S. Kellicott (pp. 81–85).—A series of notes on the life history of *Melittia ceto, Sciapteron tricincta, Ægeria corni*, and *Æ. rubristigma.*

The bean weevil, M. V. Slingerland (pp. 86–87).—In this article the normal method of oviposition is stated to be as follows: The beetle first gnaws a narrow slit through the ventral suture of the pod. It then forces its telescopic ovipositor through the slit and deposits its eggs in a cluster on the inside of the pod. The insect breeds through several generations in dry beans and is readily destroyed by bisulphide of carbon.

Drasteria erechtea, M. V. Slingerland (pp. 87, 88).—The common grass moths ordinarily known by this name are shown to comprise in reality two species, viz, *D. erechtea*, Cramer, and *D. crassiuscula*, Haworth. There are three annual generations of each species in New York, the adults appearing in May, July, and September.

Orthezia insignis as a garden pest, T. D. A. Cockerell (p. 89).—This scale insect, while common upon roadside weeds in Jamaica, is injurious to a species of Coleus and to white violets in that island.

Some features of an apparent joint-worm attack, F. M. Webster (pp. 89, 90).—An injury to wheat stems in northern Ohio which closely resembles that of the joint-worm was possibly produced by that insect.

A new enemy to timothy grass, L. O. Howard (pp. 90–92, figs. 2).—An account of damage to timothy grass by *Oncognathus binotatus* at an elevation of 2,500 feet in Greene County, New York. The different stages are figured with the exception of the egg.

Food plants of some North American Membracidæ, F. W. Goding (pp. 92, 93).—List of species with food plants indicated in tabular form.

Notes of the year in New Jersey, J. B. Smith (pp. 93–98).—A general review of the insects injuring New Jersey crops during the early summer of 1892.

The pear tree Psylla (Psylla pyricola), M. V. Slingerland (pp. 100–104).—Preliminary announcement of the facts subsequently published in Bulletin No. 44 of the New York Cornell Station (E. S. R., vol. IV, p. 472).

The pear-leaf blister mite (Phytoptus pyri), M. V. Slingerland (pp. 104–106).—Kerosene emulsion containing at least 20 per cent of kerosene was found to be a practical remedy when applied during the winter.

The parsnip web-worm (Depressaria heracliana), E. B. Southwick (pp. 106–109).—A series of observations on the life history of this insect, showing that numbers are destroyed by the potter wasp (*Eumenes fraterna*) and by a fungous disease.

Notes from the Mississippi station, H. E. Weed (pp. 110–111).—Records the occurrence of the horn fly in Mississippi, damage to beans by *Cerotoma caminea*, to lupines by *Mecyna reversalis*, and to cotton by *Arctia phyllira.*

Notes on injurious insects of 1892, H. Osborn (pp. 111–114).—In addition to a general summary of common pests in Iowa, the author treated of the life history of three of the common leaf hoppers, viz, *Agallia sanguineolenta*, *Deltocephalus inimicus*, and *D. debilis.*

Kansas notes, V. L. Kellogg (pp. 114–116).—The principal damage done to crops in this State during 1891 was by the wheat straw worm (*Isosoma tritici*).

Notes on plant faunæ, T. D. A. Cockerell (pp. 117–121).—A theoretical paper considering the question of origin of food plants of injurious species and their variation and increased injury consequent upon newly acquired food habits.

Spraying with arsenites vs. bees, F. M. Webster (pp. 121–123).—An account of a series of experiments in which bees were inclosed and forced to feed exclusively on the blossoms of fruit trees sprayed with Paris green. The results were inconclusive.

Notes on injurious insects in Canada in 1892, J. Fletcher (pp. 124–126).—A general summary of a dozen or more insect outbreaks.

An Australian Scymnus established and described in California, C. V. Riley (pp. 127–128).—It is shown that *Scymnus lophanthæ* described by

F. E. Blaisdell as a new California Scymnus is one of the species introduced by Mr. Koebele from Australia.

Further notes on the food of Limax campestris, Binney, F. M. Webster (pp. 128-130).—Records observations concerning the feeding of this slug upon plant lice.

Abstract of proceedings of the Rochester meeting of the Entomological Club of the American Association for the Advancement of Science (pp. 132-134).—A brief summary of the papers read at the meeting.

Correspondence and general notes (pp. 135-146).—Among the subjects treated are the following: Successful colonization of Vedalia in Egypt; new localities for the Mediterranean flour moth; damage by the codling moth in Nebraska; success of a Vedalia importation; quails *vs.* potato bugs; mosquito remedies again; widespread trouble from the horn fly; and tannin in a sumach plant-louse gall.

Insect Life (*Division of Entomology, Insect Life, vol. v, No. 3, Jan., 1893, pp. 147-212, figs 13.*).—This number contains the following articles:

The glassy-winged sharpshooter, C. V. Riley and L. O. Howard (pp. 150-154).—An illustrated account of the damage done by *Homalodisca coagulata*, Say, to cotton bolls and Le Conte pear, to the new growth of the orange tree, and to asparagus, the damage to cotton being more marked than the others. The insects are particularly prevalent in cotton fields which are bordered by young poplar growth, along the banks of streams, and especially in the State of Louisiana. Where the damage is great it will pay to make a single application of kerosene emulsion to the poplar growth before the insects have migrated from this to cotton in the early summer.

The osage orange Pyralid, Mary E. Murtfeldt (pp. 155-158).—An illustrated account of the life history of *Loxostege macluræ*, Riley, a new enemy to osage orange, with a description of the species.

The food plants of some Jamaican Coccidæ, T. D. A. Cockerell (pp. 158-160).—List of Coccidæ found in Jamaica with indications of food plants and localities.

The "maxillary tentacles" of Pronuba, J. B. Smith (pp. 161-163).—Homologizes the specially developed maxillary tentacle with the palpifer.

The potato-tuber moth, R. Allan Wight (pp. 163, 164).—An account of the habits of *Lita solanella*, Boisd., in New Zealand, with the suggestion that it originally attacked a flag (*Typha angustifolia*), used by the natives to thatch the roofs of their potato houses.

Food plants of North American species of Bruchus (pp. 165, 166).—A list of the food plants of the North American species of *Bruchus* drawn from the notebooks of the division and compiled from published records.

The strawberry weevil, F. H. Chittenden (pp. 167-186).—A full illustrated account of the life history of *Anthonomus signatus*, Say, drawn from the notebooks of the division and from the observations of the author. Principal subheads of the articles are: Past history; the year's

investigations; work of the insect; life history; parasites and natural enemies; and remedies. The author shows that the insect breeds in the flower heads, and that it affects certain wild plants in which it probably normally breeds, the original food plant being probably *Rubus villosus.* The parasites reared were *Calyptus tibiator,* Cr., *Bracon anthonomi,* Ashm., *Catolaccus anthonomi,* Ashm., and *Catolaccus incertus,* Ashm., the three last being new species, described by Mr. Ashmead in connection with the article. The principal remedies suggested are the use of trap crops and covering the beds at certain times.

Damage to forests by the destructive pine bark beetle, A. D. Hopkins (pp. 187–189).—An account of the damage done in Virginia and West Virginia by *Dendroctonus frontalis* to the pine forests. The extent of the damage is indicated and an account is given of the introduction of a European enemy, *Clerus formicarius,* which Mr. Hopkins went to Europe to secure.

An interesting water bug (*Rheumatobates rileyi,* Bergroth), pp. 189–194).—A full descriptive account of various stages of this insect, with illustrations.

Correspondence and general notes (pp. 194–212).—Among the subjects treated are the following: First larval stage of the pea weevil; swarming of the Archippus butterfly; some imported Australian parasites; a new parasite of the red scale; an insect transmitter of contagion.

The Russian thistle and other troublesome weeds, L. H. DEWEY (*Division of Botany, Farmers' Bul. No. 10, pp. 16, plates 2*).—A popular description of the Russian thistle or Russian cactus (*Salsola kali,* var *tragus*) with suggested means for its repression. Other weeds are described and means suggested for their extermination, as follows: Wild mustard (*Brassica sinapistrum*), worm-seed mustard (*Erysimum cheiranthoides*), treacle mustard or western wallflower (*Erysimum asperum*), false flax (*Camelina sativa*), shepherd's purse (*Capsella bursa-pastoris*), pennycress or French weed (*Thlaspi arvense*), peppergrass (*Lepidium intermedium*), wild licorice (*Glycyrrhiza lepidota*), wild rose (*Rosa blanda*), rosinweed (*Grindelia squarrosa*), goldenrod (*Solidago rugosa, S. nemoralis, S. canadensis*), marsh elder (*Iva xanthiifolia*), great ragweed (*Ambrosia trifida*), ragweed (*A. artemisiæfolia, A. psilostachya*), cocklebur (*Xanthium canadense*), wormwood (*Artemisia biennis*), tumbleweed (*Amarantus albus*), lamb's quarters or pigweed (*Chenopodium album*), winged pigweed (*Cycloloma platyphyllum*), dock (*Rumex salicifolius, R. obtusifolius, R. crispus*), black bindweed (*Polygonum convolvulus*), barnyard grass (*Panicum crus-galli*), sandbur or burgrass (*Cenchrus tribuloides*), porcupine or needle grass (*Stipa spartea*), couch, quick, or quack grass (*Agropyrum repens*), and squirrel tail grass or wild barley (*Hordeum jubatum*).

Monthly Weather Review (*Weather Bureau, Monthly Weather Review, vol.* XX, *Nos. 9–12, Sept.–Dec., 1892, pp. 235–345, charts 20*). Besides the meteorological reports usually given in this publication, the September number contains an article on a September "norther" on

the Mexican coast, and the November number articles on the tornado at Eagles Mere, Pennsylvania, June 27, 1892, and the Galveston Island tornado of November 6, 1892.

Fluctuations of the level and rate of movement of ground water, F. H. KING (*Weather Bureau Bul. No. 5, pp. 75, figs. 3, plates 6*).—This is a detailed summary of observations and experiments made since July, 1888, at the Wisconsin Agricultural Experiment Station, under the following heads: First observations; instruments for measuring changes in the level of water in wells; topography of the area occupied by the wells, geological structure of the locality; configuration of the surface of the ground water; the percolation of water into wells; a sanitary problem; one cause of decrease of head in artesian wells and at pumping stations; seasonal changes in the height of ground water; relation between the amount of rise in the surface of ground water and the rainfall; the capillary storage capacity of long columns of soil; relation of the normal gradient of the ground-water surface to tile drainage; natural subirrigation; flow of ground water from the lower under the higher lands; the rate at which the level of the ground-water surface changes; relation of the rate of fall in the ground water surface to barometric pressure; rate of change in the ground-water level from morning to evening and from evening to morning; automatic records of the fluctuations in the level of ground water; the complex character of fluctuations to which the surface of ground water is subject; influence of barometric changes on the rate of flow from springs, artesian wells, and tile drains; barometric oscillations in the level of water in wells; semi-diurnal oscillations in the level of water in wells; influence of diurnal changes in soil temperature in producing corresponding oscillations in the level of ground water; effect of increasing soil temperature on the general height of the ground-water surface; influence of changes in soil temperature on underground drainage; temperature tide of the ground-water surface; seismic oscillations of the ground-water surface; the mechanical action of barometric changes in producing fluctuations in the level and drainage of ground water; cause of temperature oscillations in the level of ground water; instantaneous percolation after rains; percolation through frozen ground; and some directions in which further study is needed.

The principal points in these investigations have already appeared in the Annual Reports of the Wisconsin Station for 1889, p. 189 (E. S. R., vol. II, p. 432), 1890, p. 120 (E. S. R., vol. II, p. 442), and 1891, p. 91 (E. S. R., vol. IV, p. 122). The present report describes and illustrates the apparatus used, especial attention being given discussions of various self-registering instruments devised by the author. Full experimental data are given in numerous tables and diagrams.

The following suggestions regarding further study in this field are made:

A careful and detailed study of the movements of ground water ought to supply very important knowledge bearing upon the contamination of drinking waters and

the spreading of certain classes of contagious diseases, and thus help to place the water supply for both urban and rural purposes under better sanitary conditions. * * *

In the utilization of natural subirrigation * * * and in the reclaiming of swamp lands for agricultural purposes, which must be of growing importance in the immediate future, there is imminent need for new knowledge in the same direction.

Before we can understand the full significance and extent of the movements of underground water, it will be necessary to have synchronous observations, covering not only considerable intervals of time, but also extended areas as well, and valuable contributions to our knowledge should be expected if improved forms of self-registering apparatus for recording the changes in the level of ground water were to be set up at many meteorological and experiment stations; and since the soil water has been shown to be so susceptible to movements resulting from small barometric and temperature changes, there should be forms of self-recording soil thermometers more sensitive than any now available, and barographs which are capable of recording much smaller changes of pressure than most existing instruments do. It may be that a barograph constructed on the principle of the air barometer described in this bulletin, but using a fixed oil instead of water, filling the chamber with chemically dry air and burying the whole more deeply in the ground where the diurnal changes of temperature would always be very small, would answer the needs of such a study.

If the movements of ground water generally even approximate those which the observations here recorded appear to indicate, a fuller understanding of them must shed much light upon those metasomatic changes which are of such great importance in geologic processes and in the origin and formation of metalliferous deposits.

Then, again, if tidal fluctuations do really exist in the ground water, as Mr. Roberts has affirmed, and if it is sensitive to seismic disturbances, as the observations recorded in regard to the moving train suggest, a study of the movements of ground water may be expected to contribute much toward an understanding of the nature, extent, and effects of the movements of the solid portions of the earth, whether they are due to stresses originating in extra-terrestrial causes or geologic or meteorologic shiftings of load upon the earth's surface.

Report of the first annual meeting of the American Association of State Weather Services (*Weather Bureau, Bul. No. 7, pp. 49, figs. 6.*—An account of this meeting was given in Experiment Station Record, vol. IV, p. 226.

Besides a full report of the proceedings, this bulletin gives appendices containing papers on exposure of thermometers and on methods of signaling weather forecasts.

Experiments with sugar beets in 1892, H. W. WILEY (*Division of Chemistry, Bul. No. 36, pp. 74*).—A record of experiments in the culture of the sugar beet, in continuation of those reported in Bulletin No. 33 of the Division of Chemistry (E. S. R., vol. IV, p. 78). The Department of Agriculture distributed 8,159 packages of sugar-beet seed and made analyses of the samples of beets sent in from different parts of the country. The details of these analyses are given in tabulated form. The averages by States and Territories are as follows:

Average results of sugar-beet trials by States and Territories.

State.	Number of growers.	Analyses of beets.			Yield of beets per acre.	Probable yield of sucrose per acre.
		Total solids.	Sucrose in beet.	Purity.		
		Per cent.	*Per cent.*	*Per cent.*	*Tons.*	*Pounds.*
Arkansas	2	15.3	9.41	64.7	....	....
California	3	20.0	14.72	77.6	15.9	3,161
Colorado	50	19.1	14.82	81.7	17.6	3,968
Idaho	1	19 5	14 65	79.1	....	....
Illinois	4	15 3	10.93	75.2	11.2	1,653
Indiana	11	16.1	11.23	72.5	11.5	1,822
Iowa	8	15.1	10.93	76.2	15.1	2,210
Kansas	9	15.7	11.07	74.2	15.0	2,281
Kentucky	1	12.1	8.86	77.2	17.5	2,186
Michigan	9	17.8	14.11	83.4	16.7	3,796
Minnesota	15	16.4	12.17	78 1	15.7	2,966
Missouri	2	13.4	8.09	63 4	....	....
Montana	1	15.8	10.93	72 8	....	....
Nebraska	9	18.8	14.15	79.3	15.7	3,036
Nevada	1	18.9	15.92	83.4	12.0	3,046
New Mexico	5	19.4	15.34	83.2	8.3	2,237
New York	4	18.9	15.43	85.9	15.4	3,815
North Carolina	1	12.9	8.99	73.4	3.6	425
North Dakota	4	17.7	12.86	76.5	22.4	3,820
Ohio	29	16.1	11.62	76.0	14.5	2,300
Oregon	6	18.7	14.24	80.2	8.6	1,487
Pennsylvania	2	14.7	10.75	75 8	4 4	918
South Dakota	20	18.3	13.12	75.5	17.5	3,434
Tennessee	1	13.7	9.42	72.4	....	....
Virginia	2	15.8	11.95	79.6	8.1	1,543
Washington	9	19.9	14.52	76.8	14.3	3,113
West Virginia	1	17.4	11.29	68.5	....	....
Wisconsin	9	17.2	12.72	77.8	16.1	2,981
Wyoming	1	18.8	15.20	85.2	....	....

Reports are given on experiments in the production of beet seed and in the culture of beets at the station at Schuyler, Nebraska, by W. Maxwell, who was in charge of the station. The beets intended for "mothers" were preserved in moist sand in silos during the winter. The "mothers" were analyzed the first week in April and were then planted in the field. The loss of sugar in the beets during storage averaged 2.85 per cent.

The vitality of the mother beets was almost perfect; not more than 20 out of 4,435 failed to grow and produce seed. The cultivation received was simply keeping the weeds down and the ground loose by hand hoeing, of which the crop received three cultivations.

The harvesting of the seed commenced on August 5 on some parts, which were prematurely ripened by the hot weather. The harvesting was finished on the 24th of August, and as a whole resulted in the production of seed of fine appearance, great vitality and excellent yield. The total area under cultivation for seed was 98.3 square rods. The total yield of seed was 595 pounds, or at the rate of 968 pounds per acre. At 15 cents per pound the value of the seed per acre would therefore be $145.20.

The interesting part of the seed-production work will come during the next season, when the home-grown seed will be compared directly with that of foreign importation. It is confidently believed that the seed produced in the locality will have superior qualities in respect of vitality and prepotency over the imported seeds.

At the present time no organized effort has been made in this country to grow high grade beet seed on a large scale to supply the demands for home consumption. During the past season about 15,000 acres of beets were cultivated in this country. At 15 pounds per acre the amount of seed required to plant this area was 225,000 pounds, and, at 15 cents a pound, the value of this seed was $33,750. Already the item of beet seed is one of considerable importance, and in common practice it may

be said that the expense of beet seed for each acre, when properly planted, will be about $2. A great increase in the acreage, therefore, sown to beets would soon create a demand for high-grade seed of home production, which would justify a reasonable amount of capital in entering into the business on a large scale.

The average results of field experiments with six varieties of sugar beets grown from imported seed were: Yield per acre, 15.8 tons; sugar in juice, 15.1 per cent; total yield of sugar per acre, 4,800 pounds. Much injury was done to the crop by the sugar-beet webworm.

The cost of production of an acre of beets upon the station field is shown in the following statement:

Cost of production of one acre of beets.

1891.				
Oct.	1.	Light plowing		$1.68
	25.	Deep plowing		2.00
	25.	Subsoil plowing		2.00
1892.				
Apr.	28.	Disk harrowing		.38
	29.	Harrowing (twice, at 17 cents)		.34
	30.	Rolling		.17
	30.	Cost of seed (17 pounds, at 15 cents)		2.55
	30.	Drilling seed		.52
	30.	Rolling		.17
June	2.	Horse hoeing		.62
	8–10.	Thinning out (sixty-five hours, at 12½ cents)		8.12
	17.	Hand hoeing (fifty hours, at 12½ cents)		6.25
	21.	Horse hoeing		.62
	27.	Horse hoeing		.62
	30.	Horse hoeing		.62
July	7.	Soiling up (twenty-nine hours, at 12½ cents)		3.62
				30.28
Oct.	15.	Getting up beets (by hand)	$13.50	
	15.	Transport (at 50 cents per ton)	6.00	
	15.	Rent of land	2.50	
				22.00
		Total cost of production		52.28

The mean value per acre of all the varieties was $63.20, giving a profit of $10.92 per acre.

Experiments with reference to the losses in the sugar content of stored beets gave interesting results.

It has been shown that when beets were harvested and exposed to the sunlight at a time of rather high temperature, not only was there a greater loss in weight in four days, amounting to as much as 37 per cent, but that also there was an actual loss in the amount of sugar contained in the beets. This loss amounted to about 29 per cent in the time mentioned. When the beets were kept in a shed, the loss in weight was also considerable, due to evaporation, but the loss in sugar was considerably less. When, however, beets were kept in cold storage or in moist earth, the temperature of which was below 40°, it was found that there was practically no loss of sugar during a period of over twenty days. There was a slight loss of moisture in the beets kept in cold storage and a corresponding increase in the amount of sugar in the juice.

In the beets kept in the moist, cold earth at a temperature below 40°, but not low enough to freeze them, there was neither loss of weight nor sugar.

The conclusion to be drawn from these interesting experiments is of a practical nature, namely, that in the preservation of beets an attempt should be made to keep them covered with moist earth and at a temperature which should not be allowed, if possible, to rise above 40°.

The idea presents itself here in a very forcible way whether or not it would be profitable for beet-sugar factories to provide cold-storage cellars for the preservation of their beets, in which the temperature could be so regulated as not to be allowed to rise above 40° or fall below 32°. In such a cold-storage cellar the beets could be kept probably for two or three months without any appreciable loss of sugar.

The bulletin also contains an account of the sugar-beet webworm (*Loxostege sticticalis*), taken from advance sheets of the report of the Entomologist, in the Annual Report of the Secretary of Agriculture for 1892.

The life history of the insect has been followed through only a part of the season, but there are certainly two annual generations, and probably three, if not four. The July brood is a short-lived one, and but two weeks are required between the maturity of the caterpillars transforming the latter part of July and the appearance of the moths, which couple and soon lay eggs for another generation. The caterpillars of the July brood transform to chrysalids almost immediately after entering the ground. Such, however, was not the case with the caterpillars of the last brood. With this the chrysalis state is normally not assumed for some time, and probably not until the ensuing spring. Cocoons received September 19 from Mr. Edson, at Schuyler, Nebraska, contained larvæ which were full-grown, but somewhat shrunken, and these at the date of writing (December 5) are still in the larval condition. Mr. Bruner, however, in breeding-cage experiments, finds that some of the August brood issue as moths during September and October, and he suggests that it is barely possible that there is another set of caterpillars produced by these stragglers during the fall if the weather permits, but, as already shown, the majority of the August brood remained unchanged until the following spring. From the larvæ of the injurious brood received July 28 and August 2 the moths issued August 6, 8, and 12, while August 15 moths were received from Schuyler, together with beet leaves bearing eggs.

The eggs are pale yellow, faintly rugose or indistinctly faceted, slightly polished, somewhat iridescent, almost circular, and very flatly convex, and are deposited either singly or in a row of from two to five or more, in the latter case overlapping each other like scales.

The young larvæ are whitish in color, with polished black head and piliferous spots. The full-grown larvæ are yellowish white with a broad black mediodorsal stripe, and a still broader subdorsal stripe, the two fine lateral lines being also black. The piliferous warts are pale with a black ring, and the head is yellowish or marbled with black. The hibernating caterpillars make a burrow beneath the surface of the ground, but line it with silk, constructing an inner cocoon, which is long, slender, slightly curved, and about three times as long as the larva itself. A somewhat similar cocoon, but a little over half the length, is constructed by the midsummer brood.

This insect is a close ally of the so-called garden webworm, which was treated in the report of the Entomologist in the Annual Report of the United States Department of Agriculture for 1885 on pages 265–270. The moth is somewhat darker in general effect; the caterpillar is also darker, and the preponderance in the longitudinal markings shows a decided difference from the normal form of the ordinary garden webworm. It also differs in the apparent absence of the spinning habit in the immature larvæ.

It is one of the insects which, during my early visits to Kansas, and particularly in 1873, was not uncommonly found on *Amarantus blitum*, and was reared to the imago from larvæ upon this plant.

Report of the statistician, (*Division of Statistics, Report No. 101, n. ser., Jan. and Feb., 1893, pp. 71*).—This includes the following articles: Agriculture in France (from a report by L. Grandeau in *Annales de la Science Agronomique, 1891*); report on Hungarian milling; the canning industry; tobacco experiments in Texas; European crop report for February; farm animals of the world, and freight rates of transportation companies.

The total number of cases of canned tomatoes packed in 1892 in the United States was 3,223,165; corn, 3,417,190. The demand for the higher grades of canned corn keeps ahead of the supply.

The following is a summary of the numbers of farm animals in different parts of the world:

Farm animals of the world.

Grand division.	Cattle.	Horses.	Mules and asses.	Sheep.	Swine.	Goats.
North America	57,887,438	17,717,139	2,391,738	51,292,797	48,059,045	45,536
South America	57,610,183	5,486,036	1,666,225	96,242,137	2,723,516	2,695,697
Europe	104,430,093	36,483,400	3,155,297	187,144,203	49,164,341	18,941,295
Asia	60,846,904	4,279,241	1,079,723	39,922,366	488,937	1,616,934
Africa	6,094,883	1,238,574	390,059	35,589,208	546,909	12,566,612
Australasia	11,872,360	1,786,644	....	121,645,606	1,156,325	116,257
Oceanica	131,796	4,066	110	12,607	33,151	13,102
Grand total	298,873,657	66,995,100	8,683,152	534,848,924	102,172,224	36,025,433

Numbers and values of farm animals, and cotton distribution (*Division of Statistics, Report, Jan. and Feb., 1893, pp. 20*).—Notes and tabulated data regarding the numbers and values of farm animals in the United States in 1892, and the distribution of the cotton crop of 1892.

A comparison of the numbers and values of farm animals for the past two years is given in the following tables:

Numbers and values of farm animals, 1892 and 1893.

Stock.	Number.		Increase or decrease.	Value.		Increase or decrease
	1892.	1893.		1892.	1893.	
Horses	15,498,140	16,206,802	+ 708,662	$1,007,593,636	$992,225,185	—$15,368,451
Mules	2,314,699	2,331,128	+ 16,429	174,882,070	164,763,751	— 10,118,319
Milch cows	16,416,351	16,424,087	+ 7,736	357,299,785	356,876,353	+ 5,921,653
Oxen and other cattle	37,651,239	35,954,196	—1,697,043	570,749,155	547,882,204	— 22,866,951
Sheep	44,938,365	47,273,553	+2,335,188	116,121,270	125,909,264	+ 9,787,994
Swine	52,398,019	46,094,807	—6,303,212	241,031,415	295,426,492	+ 54,395,077
Total	....	....	....	2,483,506,681	2,483,083,249	+ 21,751,003

Value of farm animals per head.

Stock.	Value.		Increase or decrease.
	1892.	1893.	
Horses	$65.01	$61.22	—$3.79
Mules	75.55	70.68	— 4.87
Milch cows	21.40	21.73	+ 0.33
Oxen and other cattle	15.16	15.24	+ 0.08
Sheep	2.58	2.66	+ 0.08
Swine	4.60	6.41	+ 1.81

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

The direct determination of nitrogen in nitrates, A. DEVARDA (*Chem. Ztg., Dec., 1892, p. 1952*).—The method proposed, which is similar to that of Böttcher already noted (E. S. R., vol. IV, p. 583), is as follows: Ten grams of nitrate are dissolved in 1 liter of water and 50 c. c. of the solution, corresponding to 0.5 gram of nitrate, are mixed in a 600 to 1,000 c. c. Erlenmeyer flask, with about 60 c. c. of water, 5 c. c. of alcohol, and 40 c. c. of potash solution of a density of 1.3. To this is added 2 to 2.5 grams of an alloy of 45 parts of aluminum, 50 parts of copper, and 5 parts of zinc in fine powder, and the flask immediately connected with a distilling apparatus.

This distilling apparatus is simply two glass tubes connected by rubber tubing. The part connected with the distillation flask is about 30 to 35 cm. long and 1 cm. wide, having in the middle a bulb about 30 cm. wide, partially filled with glass beads. The part connected with the flask containing the standard acid is drawn out to a fine point below and is enlarged above in the form of a pipette (of 50 c. c. content). This apparatus completely prevents the carrying over of solutions from one flask to the other.

The distillation flask is gently heated at the beginning to start the evolution of gas, but requires no further attention until the reaction is complete. After about an hour, as indicated by a cessation of the evolution of hydrogen, the reduction of nitrate is complete. Heat is then applied, and the distillation commenced, slowly at first, but gradually hastened, so that the entire operation shall not require more than twenty minutes from the beginning of the distillation. The ammonia is collected in standard sulphuric acid, and titrated with barium solution. On pure nitrate of potash and nitrate of soda this method gave practically theoretical results, as the following figures show:

	Nitrogen	
	Calculated.	Found.
	Per cent.	*Per cent.*
Nitrate of potash	13.86	13.88
Nitrate of soda	16.47	16.46

The method is applicable to nitrates and ammonium compounds, but not to materials containing organic nitrogen.—W. H. B.

A source of error in the determination of phosphoric acid by magnesia mixture, N. VON LORENZ (*Zeitsch. Analyt. Chem., 32, pp. 64–67*).—The author observed that when phosphoric acid was precipitated by magnesia mixture in solutions containing even one half per cent of citric acid, the magnesium pyrophosphate obtained weighed a few milligrams less than when the solutions contained no citric acid.

To determine the cause of the increase of weight in absence of citric acid the following experiments were made: Ten 50 c. c. lots of a solution of chemically pure mono-ammonium phosphate, $NH_4H_2PO_4$, were measured into beakers, 100 c. c. of 2 per cent ammonia solution added to each, and the phosphoric acid precipitated with magnesia mixture. The average of the closely concordant results of this series was 0.3312 gram of magnesium pyrophosphate (?). Ten 50 c. c. lots of the same solution measured out separately were evaporated in two portions of 250 c. c. each in platinum dishes containing 5 grams of ignited zinc oxide, ignited, and weighed. The average of the results of the two tests, which agreed closely, was 3.2833 grams of magnesium pyrophosphate, the average for each 50 c. c. being 0.3283 gram. The difference between the results of the two methods is 0.0029 gram. To determine whether this increase of weight was due to the presence of magnesia in the precipitate, the washed ammonio-magnesium phosphate obtained by precipitation was dissolved in hydrochloric acid, 20 mg. of phosphoric acid (P_2O_5) added, and the ammonio-magnesium phosphate again precipitated and washed. The average weight of magnesium pyrophosphate obtained in three tests of this kind was 0.3360 gram. The average of the 10 direct precipitations, as already shown, was 0.3312 gram. The difference, 0.0048 gram, must be the phosphoric acid (P_2O_5) required to combine with the magnesium hydroxide in the first precipitate.

Now, if citric acid prevents the precipitation of magnesium hydroxide, treatment of the ammonio-magnesium phosphate precipitated in the presence of citric acid in the manner just described should give no increase of weight. This was found to be the case in tests in which 2 per cent of citric acid in the form of ammonium citrate was added before precipitation. The average weight of ammonio-magnesium phosphate obtained in three direct precipitations was 0.3283 gram, in three cases of solution in hydrochloric acid, addition of phosphoric acid (P_2O_5), and reprecipitation, 0.3281. These figures agree closely with the absolute weight as obtained by evaporation with zinc oxide (0.3283 gram).

In order to accurately determine phosphoric acid, the solution of this substance should contain 2 per cent or more of citric acid in the form of ammonium citrate, and the magnesia mixture should be added, with proper stirring, from a pipette with a small outlet.—W. H. B.

A contribution to the knowledge of the genus Carex, ALFRED LEMCKE (*pp. 128*).—The author examines the proposed classifications of Laux who divides the genus into two classes and nine groups, and

also the groupings of Mazel, Nyman, Christ, and others. He objects to the use of characters of unexplained physiological functions and morphological relations in forming a basis of classification, as is done by Laux upon the form of the fibro-vascular bundles in the rhizome whether collateral or concentric in arrangement of phlöem and xylem. The author has made a study of 170 species of Carices as to the anatomy of their rhizomes, stems, and leaves. Based upon the structures revealed in cross-sections of these parts of the plant, he has formed a classification into three groups and thirty-three sections. The section most used is that of the rhizome, emphasizing the necessity of complete material for critical study of this difficult genus.—W. H. E.

The exchanges of carbonic acid and oxygen between plants and the atmosphere.—T. SCHLÖSING, JR. (*Compt. rend.*, *115 (1892), pp. 881–883 and 1017–1020*; *and Ann. Inst. Pasteur*, *7 (1893), pp. 28–40, fig. 1*).—Previous experiments with reference to the exchanges of carbonic acid and oxygen between plants and the atmosphere have been conducted with parts of plants and have generally been of short duration. The author determined to study entire plants for a longer period, under conditions largely within his control. The method adopted was to grow plants in closed vessels into which was introduced an artificial atmosphere containing known quantities of nitrogen, carbonic acid, and oxygen. The apparatus used was the one employed by the author and Laurent in studies on the fixation of free nitrogen by plants.* The seeds were sown at one time, and after a vacuum had been created in the apparatus, carefully measured volumes of oxygen and nitrogen were introduced. During the growth of the plants the atmosphere inside the apparatus was analyzed from time to time and carbonic acid was added, as required, in quantities accurately determined, or deprived of a portion of its oxygen by being passed over heated copper. Finally the gases were drawn off and measured, the proportion of each being determined by eudiometric analysis. The amount of oxygen fixed by the copper was also determined. When the different determinations were completed, the total quantity of carbonic acid absorbed and of oxygen exhaled by the plants was easily calculated. To reduce as much as possible the disturbing influence of the soil on the absorption of carbonic acid and the exhalation of oxygen the plants were grown in quartz sand almost entirely free from organic substances. In the first two experiments a small quantity of carbonate of lime and nutritive solution was added to the sand, and the surface layer of this soil was calcined to prevent the growth of algæ. Parallel with the other experiments, the amounts of carbonic acid given off and of oxygen absorbed by this soil when free from vegetation were determined, and allowance was made for this factor in calculating the results of the experiments with plants.

* Compt. rend., 111 (1890), p. 750, and 113 (1891), pp. 776–779; E. S. R., vol. III, pp. 116 and 551.

The tabulated summary of the experiments is as follows:

Carbonic acid absorbed and oxygen exhaled by plants.

	Experiment I.		Experiment II.		Experiment III.	
Kind of plant	Large-leaved cress.		Feather grass		Feather grass.	
Time of sowing seed	April 28		April 28		July 7.	
Time of cutting plants	June 14		June 10		September 6.	
Weight of seeds ... mg		43.7		50.0		20.0
Nitrogen used ... c.c.		2,815.0		2,735.0		3,925.0
Carbonic acid introduced ... do.	1,371.8	1,383.8	1,546.0	1,558.0	1,540.0	1,551.0
Carbonic acid given off by the soil ... do.	12.0		12.0		11.0	
Carbonic acid gas found at the end of the experiment ... c.c.		21.3		57.0		23.6
Carbonic acid absorbed by the plants ... do.		1,171.5		1,501.0		1,527.4
Oxygen introduced ... do.		915.7		911.2		1,174.2
Oxygen extracted as gas ... do.	1,142.0	2,474.9	971.4	2,747.2	2,898.1	2,909.1
Oxygen fixed by copper ... do.	1,325.4		1,763.8			
Oxygen absorbed by soil ... do.	12.0		12.0		11.0	
Oxygen exhaled by plants ... do.		1,563.4		1,836.0		1,734.9
Ratio of carbonic acid absorbed to oxygen exhaled		0.75		0.82		0.89*

* In the third experiment the ratio of carbonic acid absorbed to the oxygen exhaled as determined at different dates was as follows: August 13, 0.87, August 18, 0.88, August 26, 0.88, September 1, 0.91, September 6, 0.89.

At the end of experiment III, the plants, which were very green and vigorous and had reached a height of from 22 to 35 cm., were analyzed with the following results:

Composition of the whole plants of feather grass.

	Grams.	Per cent.
Carbon	0.827	39.1
Hydrogen	0.106	5.0
Nitrogen	0.060	2.8
Ash (without carbonic acid)	0.421	19.9
Oxygen (by difference)	0.704	33.2
Whole plants (dry)	2.018	100.0

Among the conclusions drawn from these experiments are the following:

(1) The ratio of the volume of carbonic acid absorbed to that of the oxygen exhaled during the first six or eight weeks of the growth of the plants examined was less than unity and did not materially vary during this period. The larger proportion of oxygen used in experiment III did not materially affect this ratio.

(2) In the organic substance of an entire plant there is an amount of hydrogen beyond that which will form water by union with the oxygen of this substance. The author's experiments agree with those of Dehérain and Maquenne in indicating that one cause of the deficiency of oxygen was the exhalation of a certain quantity of carbonic acid, the two elements of which were furnished by the plant itself.

(3) The oxygen in the organic substance of the plants in experiment III was derived not only from water and the atmosphere but also in an

important degree from the mineral salts of the soil—the sulphates, phosphates, and especially the nitrates.—A. C. T.

The modifications of transpiration and absorption in plants due to freezing, A. PRUNET (*Compt. rend., 115 (1892), pp. 964–966*).—It is well known that one of the effects of freezing on plants is a rapid withering of the young shoots, which is apparently due to modifications in absorption or transpiration, or in both these processes, at the time of thawing. The author undertook to obtain experimental evidence regarding the nature and extent of these changes and the conditions under which they occur. His experiments were on grape, bean, peach, pear, and honeysuckle (*Lonicera balearica*) plants. Portions of the plants were frozen in air rapidly cooled by the evaporation of ether, under such conditions as secured the desired temperature for a sufficient length of time. The experiments in general showed that the frozen shoots, after thawing, gave off much greater quantities of water than shoots which had not been frozen. For example, a young shoot of a grapevine, which had given off an average of 68 mg. of water per hour before freezing, gave off 475 mg. of water and lost 14.46 per cent of its weight in two hours after thawing. A similar shoot, not frozen, one end of which was hermetically sealed in a vessel filled with water, gave off 132 mg. of water and gained 0.26 per cent in weight, and another similarly placed in an empty vessel gave off 115 mg. of water and lost 3.57 per cent of its weight.

Shoots and leaves placed after freezing and thawing under a bell jar containing air saturated with moisture did not give off water when exposed to light, thus indicating that the losses of water by plants after thawing are due to evaporation and not to transpiration.

It was also shown by these experiments that the absorption of water by shoots which had been frozen was reduced, or entirely stopped, at least during the period immediately following thawing, *i. e.*, at the very time when they were giving off water in considerable quantities. Within certain variable limits absorption and generally transpiration were modified in proportion as the freezing was intense and prolonged. The elevation of the temperature after freezing with the same rapidity and to the same extent resulted in the evaporation of different quantities of water by different shoots in a given time. This indicates, when taken in connection with the other phenomena observed in this research, that the reduction of absorption and the increase in vaporization after thawing is due not simply to the rise of temperature, but rather to changes in the structure of the plants from freezing. The more or less rapid withering of buds and young shoots after freezing is explained by the coexistence at the time of thawing of an intense evaporation and a feeble absorption in connection with the diverse conditions which affect absorption and evaporation, viz, intensity and duration of the freezing, temperature, and humidity.—A. C. T.

The formation of protein in the plant and the relation of phosphoric acid to the same, A. MAYER (*Landw. Vers. Stat.*, *41*, *pp. 133–141*).—It has been a matter of controversy whether phosphoric acid is especially necessary to the formation of protein substances in the plant, theory and practical experience being apparently somewhat at variance on this point. To study the question, rye and meadow grasses, each growing on two plats, one of which had been manured with nitrate, the other with kainit and superphosphate, were analyzed. The results calculated to air-dry substance are shown in the following table:

Protein in rye receiving nitrogenous and nonnitrogenous manures.

	Protein.		Ash.	
	With nitrate.	Without nitrate.	With nitrate.	Without nitrate.
	Per cent.	*Per cent.*	*Per cent*	*Per cent.*
Rye cut May 12	33.6	23.4	8.3	9.3
Rye cut June 24	9 5	6 5	5.1	4.5
Rye cut August 17	7.4	5 5	3.9	3 6
Meadow hay	28.2	21.4	7.3	10.9

It will be observed that the per cent of protein was highest throughout with the nitrate. The per cent of ash was highest in the first period in the rye receiving kainit and superphosphate, but this superiority is not sustained in the next two periods. Analysis of the rye cut May 12 showed the percentage of true albuminoids in the crude protein to be practically the same (70 and 71 per cent) with the two methods of manuring. With the meadow grasses the percentage was higher, being 79 and 83 per cent, respectively. Determinations of the amounts of nitrates present in the rye and grass showed that they were not sufficiently large to affect to an appreciable extent the above results. Comparing the phosphoric acid in the rye cut May 12 and June 24, we have the following results:

Phosphoric acid and nitrogen in rye receiving different manures.

	Cut May 12.		Cut June 24.	
	With nitrate alone.	With kainit and superphosphate.	With nitrate alone.	With kainit and superphosphate.
Phosphoric acid ... per cent..	1.54	1.50	0 80	0.68
Ratio of phosphoric acid to nitrogen	1.3.2	1:2.5	1:1.9	1.1.5

These results do not allow of the conclusion that phosphoric acid does not play an important part in the formation of protein, but they show that the power of the plants to draw on the phosphoric acid of the soil was greatly increased by manuring with nitrate, and that the soil was not sufficiently exhausted to yield conclusive results.

In order to further test this point four zinc pots were filled with ster-

ile siliceous sand—two manured with nitrate of soda, gypsum, and kainit, and two with superphosphate and kainit—and planted with rye. Owing to the deficiency of plant food the plants grew poorly. Two pots were harvested June 1; the other two were not ready for harvesting until July 14. The results with the first two were—with nitrogen, 7.0 per cent of protein, with phosphoric acid, 6.7 per cent; with the second two the results were—with nitrogen, 3.7 per cent of protein, with phosphoric acid, 4.1 per cent. These results show that nitrogen did not increase the production of protein in the plant when phosphoric acid was entirely absent.

The yield was small, because in each case one essential element of plant food was wanting. The composition of the product differed but slightly, because where nitrate was added there was no phosphoric acid to promote its action.

It appears that a certain amount of phosphoric acid in the soil is essential to the most efficient action of nitrate.—W. H. B.

The drainage water of cultivated soil, P. P. DEHÉRAIN (*Ann. Agron., 19 (1893), No. 2, pp. 69–89, fig. 1*).—An abstract of a former paper by the author on the drainage water of bare soils will be found in E. S. R., vol. IV, p. 295. In all previous experiments in this line the author has grown plants in pots containing about 60 kg. of soil. In these the conditions have been abnormal and the results generally unsatisfactory.

The experiments here reported (commenced in the fall of 1891) were carried out in vegetation cases constructed as follows: In a trench 2 meters wide, 1 meter deep, and 40 meters long, twenty parallel cases were constructed of 4 cubic meters content, and holding about 5 tons of earth. The bottoms and sides of these cases consist of a framework of iron, filled in with cement, which renders them perfectly impermeable. The bottom inclines from the sides toward the middle and from the back toward the front, forming a gutter. In the lowest part of this gutter there is an opening fitted with a lead pipe, which dips into a funnel supported on a bottle provided for the reception of the drainage waters.

These bottles stand in niches under the front of the cases which are separated by brick supports. Access to the bottles is gained by a ditch, one end of which slopes gradually to the surface of the ground.

These cases admit of the culture of the larger farm plants under approximately normal conditions.

Proceeding on the assumption that the losses of phosphoric acid and potash in drainage water are insignificant, or, if not, cheaply returned to the soil, the author has devoted himself exclusively to a study of the losses of the more expensive element nitrogen which always occurs in considerable quantities in drainage water.

For the purpose of carrying out this line of inquiry the cases described above were filled with soil, in which very light fine sand predominated over the clay. Both the soil and subsoil were analyzed at the beginning

of the experiment. Some of the cases remained fallow without manure, while others received different kinds of fertilizers (barnyard manure, superphosphate, nitrate of soda, etc.), and were planted with sugar beets, common beets, potatoes, rye grass, wheat, corn, oats, and clover.

From the meteorological observations made in connection with these experiments it appears that the total rainfall during 1892 was 452.9 millimeters; but this rainfall was badly distributed, being very small at a time (April and May) when moisture is much needed and abundant toward the end of June. Between June 20 and July 21 the cases became saturated and the drainage water began to flow.

From the cultivated soils the drainage was much less than from those left fallow; in fact the drains of the former ran only three times during the season.

The following tables give in detail the results obtained on the different vegetation cases:

Yield per hectare of the vegetation cases, 1892.

No.	Crop.	Fertilizer per hectare.	Yield per hectare.
1	None	None	
2	Rye grass	None	Hay, 6,000 kg.
3	Sugar beets	30,000 kg. of manure	Roots, 38,250 kg.
4	......do	30,000 kg. of manure, 250 kg. of nitrate.	Do.
5	......do	625 gr. of nitrate, 200 gr. of superphosphate.	Do.
6	Wheat	15,000 kg. of manure	Grain, 15.75 qm., straw, 37.50 qm.
7	Wheat, followed by vetches.	15,000 kg. of manure, 200 kg. of nitrate.	Grain, 17.00 qm., straw, 40.00 qm.
8	......do	500 kg. of nitrate, 200 kg. of superphosphate.	Grain, 19.25, straw, 37.50.
9	Potatoes	30,000 kg. of manure	Tubers, 37,500 kg.
10	......do	30,000 kg. of manure, 250 kg. of nitrate.	Tubers, 36,500 kg.
11	......do	625 kg. of nitrate, 200 kg. of superphosphate.	Tubers, 36,250 kg.
12	None	30,000 kg. of manure	
13	None	30,000 kg. of manure, 250 kg. of nitrate.	
14	None	625 kg. of nitrate, 200 kg. of superphosphate.	
15	Corn	30,000 kg. of manure	Green fodder, 77,500 kg.
16	Clover	None	Hay, 2,750 kg.
17	Oats and clover	None	Grain, 24.00 qm., straw, 27.50 qm.
18	Beets (for seed)	30,000 kg. of manure	Seed, 2,134 kg.
19	......do	30,000 kg. of manure, 250 kg. of nitrate.	Seed, 2,513 kg.
20	......do	625 kg. of nitrate, 200 kg. of superphosphate	Seed, 3,214 kg.

Nitrogen in the crop and drainage water of the vegetation cases, 1892.

No.	Crop.	Nitrogen in crop.	Drainage water.	Nitrogen per cubic meter.	Nitrogen removed by the drainage water.	For 100 parts of nitrogen in the crop the drainage water removed.
		Kilos.	*Mm.*	*Grams.*	*Kilos.*	
1	None		89.0	158	140.6	
2	Rye grass	77.5	27.7	69	19.2	23.50
3	Sugar beets	Roots and leaves, 120	14.0	31	4.4	3.67
4	...do	...do	8.0	39	3.2	2.62
5	...do	...do	13.7	95	13.0	10.80
6	Wheat	Grain and straw, 51.75	39.7	139	54.6	105.50
7	Wheat, followed by vetches.	Grain and straw, 55.50	16.8	114	17.0	30.70
8	...do	Grain and straw, 59	18.8	94	17.9	30.30
9	Potatoes	Tubers and vines, 162.50	27.6	67	18.2	11.38
10	...do	Tubers and vines, 153.50	28.7	59	16.6	11.03
11	...do	Tubers and vines, 157.50	29.3	67	19.7	12.80
12	None		97.7	122	121.2	
13	None		102.2	153	156.5	
14	None		99.2	146	144.8	
15	Corn	190	16.2	89	14.5	7.65
16	Clover	55	29.7	85	25.4	46.10
17	Oats and clover	Grain and straw, 56	21.7	143	31.1	55.60
18	Beets (for seed)		44.2	101	44.8	
19	...do		50.1	93	46.9	
20	...do		42.8	123	53.3	

The results are discussed in detail, and the relation between the nitrogen in the crop and in the drainage water is shown graphically. A brief summary of this discussion is given below.

The table clearly brings out the fact that the amount of nitrogen per cubic meter of drainage water varies between relatively narrow limits. It is true that the drainage water from the bare soil is in general richer in nitrogen, but with a number of cultivated soils the amounts are quite high; in a few instances practically as high as in the water from bare soil. When, however, the losses per hectare are calculated the numbers are very different. As compared with 156.3 kilograms for No. 12, 142.5 for No. 1, we have 54.6 kilograms for No. 6, 50.3 kilograms for No. 20, etc.

These differences are due not to the richness of the drainage waters, but to their relative abundance.

The bare soil yielded almost 1,000 cubic meters of drainage water, while the cultivated soil as a rule furnished not more than a third to a half as much—with wheat (not followed by fallow crop) one fourth, and with potatoes still less.

It is therefore more the quantity than the richness of drainage water which determines the loss of nitric nitrogen.

With those plants which are vigorous, and which occupy the soil a long while, the losses are smallest, while with those plants which are of small growth, and which are ready for the harvest in a short time, the losses become considerable. A cultivator who fails of a good crop suffers not only from the limited yield, but also from the loss due to the leaching out of nitrates by the drainage water.

To leave the soil bare during the latter part of the season is there-

fore extremely dangerous. It may result in a loss as high as 50 kilograms of nitric nitrogen, or an amount equal to that in 330 kilograms of nitrate of soda.—W. H. B.

The influence of water on the growth of plants in soils of various physical properties, E. WOLLNY (*Forsch. Geb. agr. Physik., 15 (1892), pp. 427–432*).—In a former article* the author has shown that variations in the amount of water in the soil exert a marked influence on their productive capacity. It appeared that the formation of organic matter in the plant increased with the increase of moisture up to a medium degree, decreased when the moisture was increased beyond this point, and finally ceased when the soil became saturated. Repeated observations have shown that the relative efficiency of different amounts of water in the soil is determined to a large extent by the physical properties of the soil. The attraction of the soil constituents, capillarity, etc., must markedly affect the amount of soil water appropriated by the plant.

To obtain additional experimental evidence on this important point the same plant was cultivated in three soils of different physical properties—sand, clay loam, and humus (peat)—with varying amounts of water. Ten glazed flower pots of a little over 3,550 c. c. content were supplied with the same volume (3,550 c. c.) of each soil (shaken down or gently pressed). The ten pots in each series were then moistened with amounts of water ranging from 5 to 60 per cent by volume, fertilized with a manure containing equal parts of fecal guano, Peruvian guano superphosphate, and kainit, and planted in 1890 with rye, and in 1891 with peas. The losses of moisture by evaporation were supplied daily, so that the moisture content of the soils was kept constant throughout the experiments. The principal results are shown in the following table:

Yields of rye and peas on different soils with varying amounts of moisture.

Number.	Water content of the soil.	Total yield.					
		Sand.		Loam.		Peat.	
		Rye.	Peas.	Rye.	Peas.	Rye.	Peas.
	Per cent.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
1	5	0.7	0.1	0.0	0.0	0.0	0.0
2	10	4.1	0.6	2.3	0.4	0.0	0.5
3	15	8.9	21.5	3.8	4.0	1.5	5.5
4	20	12.1	24.1	9.2	9.6	2.7	20.7
5	25	18.2	33.7	13.9	16.9	14.5	24.4
6	30	19.2	39.1	15.0	27.5	16.8	28 6
7	35	20 0	36.6	19.3	29.3	22.4	36.7
8	40	23.3	43.4	17.5	36.7	24.8	43.1
9	50	33.5	50.1	24.6	46.6	34.7	50.8
10	60	25.3	43.0	27.5	57.0	38.5	61.1

The table shows that in the sand the plants required much less moisture for growth than in the clay and peat. Even with water contents of 5 to 15 per cent, plants grew in the sand, while they failed to grow

* Forsch. Geb. agr. Physik., 10 (1887), pp. 153–178. (See also E. S. R., vol. IV, p. 530.)

in the other soils. The yield on the sand increased with the water content up to 50 per cent, but decreased beyond that point. With the clay and peat, on the other hand, the yield steadily increased throughout, being highest with the water content of 60 per cent.

These results are explained by variations in the surface attraction, imbibition by the colloidal elements, and capillarity in the different soils. Since surface attraction increases with the fineness of the soil particles, the comparatively coarse sand yielded up its water to the growing plant more readily than the finer clay and peat. Besides, the colloidal clay in loam and humus acids in the peat possess the power of retaining water in an unusual degree. Finally, as is well demonstrated, the force of the capillarity increases with the fineness of the soil particles. This force, therefore, is less active in retaining the water in the sand than in the loam and peat.

In general it appears, then, that the forces with which the soil opposes the absorption of water by the roots of plants increases with fineness of its particles and its content of colloidal substances.—W. H. B.

The loss of nitrogen in manure, A. MÜNTZ AND A. CH. GIRARD (*Ann. Agron. 19 (1893), No. 1, pp. 5–49*).—The loss of fertilizing materials in farm manure has been the subject ot many investigations. Boussingault, Voelcker, Kühn, Wolff, Holdefleiss, Dehérain, Schlösing, sr. and jr.,* and Joulie, are among those who have given attention to the subject, some studying more complex problems in the laboratory, others devoting themselves to the more practical phases of the losses occurring under natural conditions and the means of preventing these losses.

Almost all of the investigators who have studied the loss of nitrogen have directed their efforts toward ascertaining the nature and causes of the loss of this element in manure in heaps. They have generally neglected to study the loss which excrement suffers in the stables, under the feet of the animal, from the time when it is ejected until it is removed and carried to the heaps.

It is principally this neglected stage which has engaged the attention of the authors. While measuring the loss of nitrogen they have endeavored at the same time to ascertain the causes to which it is due and the conditions which vary its intensity. The results summarized in this article have been obtained in experiments carried out during six years in cow sheds, horse stables, and sheepfolds, under conditions which obtain in practical agriculture.

The results are discussed under three heads: (1) Losses in stables, (2) means of reducing the loss of nitrogen in stables, and (3) loss of nitrogen in the manure heap.

In the first case the method pursued was as follows: The nitrogen was determined in the food consumed and in the litter added; in the animal products obtained—meat, milk, and wool—and in the manure

* E. S. R., vol. III, p. 737.

removed from the stable. The difference between the nitrogen in the food and that in the animal products and manure was taken as representing the amount of that element which had escaped into the air.

The observations of the authors lead to the conclusion that the fermentation going on in manure under the feet of animals is almost exclusively ammoniacal, and that there is practically no evolution of free nitrogen, as occurs in manure heaps.

In estimating the gain or loss of nitrogen in the animal organism, the live weight gained or lost was assumed to contain on an average 3 per cent of nitrogen, a figure based on investigations similar to those of Lawes and Gilbert. The average composition of the milk and wool was determined by analysis in each case. In every case the stables were provided with impervious floors to prevent loss of the liquid manure.

The one experiment with horses lasted from July 9 to August 10. The litter was oat or wheat straw, and the feed, oats, hay, and bran. The loss of nitrogen was 28.7 per cent of that ingested.

Four experiments with milch cows from about two weeks to a month in duration (one without, the others with litter), with mixtures of grain and dry food, gave losses of nitrogen as follows: 27.2 per cent (without litter), 36.3 per cent, 31.9 per cent, and 35.2 per cent, or a mean of 32.6 per cent of the nitrogen in the food consumed.

Six experiments with sheep were conducted as follows: A lot of about 25 sheep were placed in a sheepfold with an asphalt floor. Litter was added at the beginning of the experiment in sufficient quantity to insure throughout the experiment proper bedding and a complete retention of urine. The duration of the experiments varied from twenty-one to twenty-three days in five cases. The sixth experiment lasted about eleven months, and a great variety of foods was used. The loss of nitrogen varied from 44 to 55 per cent, with an average of 48.8 per cent, or nearly one half of the nitrogen consumed.

It appears that the greatest loss is with sheep. This is explained by the facts that the litter was less frequently renewed and the urine was more concentrated, and consequently subject to greater loss of ammonia by fermentation.

In studying the causes of the variation in the loss of nitrogen, it was found that with dry food the loss was greater than with wet; that the loss was not affected by the amount stored in the animal organism; and that the loss was much larger in summer than in winter, due to increased temperature and ventilation.

It appears that as soon as excrement is ejected, ammoniacal fermentation is rapidly set up by the organisms present in the litter, so that in a few hours appreciable quantities of ammonia are formed. Experiments at temperatures varying from 2° to 30° C. on the solid and liquid excrement, separately, show that ammoniacal fermentation went on in the urine very rapidly, finally transforming almost the total amount of nitrogen present; while the solid excrement under the same conditions

gave only small quantities of ammonia and showed a tendency to retain its nitrogen in the form of organic combinations.

Under the head of means of reducing the loss of nitrogen the results of experiments with litter of straw, with peat, and with earth are discussed. Straw in whatever quantity was not found capable of entirely preventing the loss of ammonia; peat was more effective than straw, but was not entirely satisfactory; earth was found to be very efficacious, reducing the loss of nitrogen 50 per cent. It, moreover, promoted nitrification. It is, however, not recommended as a substitute for straw or peat, on account of the labor involved in drying and handling. A mixture of straw and peaty or humous earth is thought to be most desirable.

The bearing of these facts on the theory of the practice of parking or hurdling (*parcage*) is discussed. It was found that the soil was more satisfactorily fertilized with the manure of sheep hurdled on the land than by the manure of the same sheep obtained during confinement in the fold. Experiments with different soils are reported, showing a decided increase in their absorptive power for ammonia with the increase of organic matter.

Several chemical agents for reducing the loss of nitrogen were investigated, viz, lime, plaster, sulphate of iron, carbonate of lime, and phosphate of lime. The results were in no case satisfactory. It was found that the alkalinity of the manure was so large as to require a large proportion of the agents for its neutralization, thus seriously impairing their efficiency.

The following table gives a résumé of the results with sulphate of iron as a preservative agent:

Sulphate of iron required to prevent loss of nitrogen in manure.

	Horses.	Cattle.	Sheep.
	Pounds.	*Pounds.*	*Pounds.*
Manure produced per animal per year	22,440	25,080	1,760
Nitrogen lost in the stable per animal per year	28.38	101.64	15.18
Ferrous sulphate required to fix this nitrogen	324.28	1,161.60	173.36
Ferrous sulphate neutralized by fixed alkalies	121.44	365.86	30.14
Total ferrous sulphate used	445.72	1,527.46	203.50

In experiments on the loss of nitrogen from manure in heaps it was found that this loss was much less than that in the stable. In the latter case the figures were 29, 33, and 50 per cent of the nitrogen consumed by the horses, cows, and sheep, respectively. In the former they were 20, 10, and 5 per cent.

The loss of potash and phosphoric and is due to leaching. The loss of nitrogen is largely due to the same cause, but a small part escapes in the free state.

The principal results of these investigations may be summarized as follows:

(1) There is a large loss of nitrogen in stables under the feet of animals, due to ammoniacal fermentation.

(2) Differences in this respect depend, to a certain extent, on the nature of the litter. The use of peat and of earth rich in humus reduces this loss in part.

(3) The neutralization of the chemical agents recommended for fixing ammonia, by the fixed bases of the manure, necessitates the use of large quantities of these substances in order to attain the desired result. The economical value of these agents is in this way to a great extent destroyed.

This question of the prevention of loss of nitrogen in manure is of great practical importance. If we could return to the soil all the nitrogen in the manure of animals there would be little need to resort to the use of expensive commercial fertilizers such as sulphate of ammonia and nitrate of soda. The fixation of the nitrogen of the air by the soil and by certain species of plants, the prevention of loss of ammonia from manure, and of nitrates in the drainage water by fallow crops, as recommended by Dehérain (E. S. R., vol. III, p. 493), would permit of a very large increase of the nitrogen supply to plants without having recourse to high-priced nitrogenous fertilizers.—W. H. B.

Effect of applications of potash salts to the soil on the beet nematode (Heterodera schachtii), M. HOLLRUNG (*Zeitsch. landw. Cent. Ver. Sachs., Dec., 1892, No. 12, pp. 419–425*).—Under the auspices of the Agricultural Union of Saxony and at the suggestion of the Stassfurt Potash Syndicate, the latter of which called attention to investigations at the New Jersey Station (E. S. R., vol. III, p. 610) on the effect of potash salts on wireworms, the author undertook the study of the effect of various potash compounds on beet nematodes.

Nematode embryos were treated on a microscope object glass with with water and with solutions of kainit, carnallit, chloride of potassium, and sulphate of potassium of different strengths (0.1, 0.5, 1, 2.5, and 5 per cent) for periods of five minutes, and one half, 3, 24, 48, 72, and 96 hours.

The results seem to indicate that potash salts in amounts in which they can be used as fertilizers are not capable of lessening "beet sickness" of soils, produced by nematodes (E. S. R., vol. III, p. 820). The beneficial effects of potash salts on such soils are due to other chemical or physical causes.—W. H. B.

Ladoga wheat, W. SAUNDERS (*Canada Central Experimental Farm Bul. No. 18, Feb., 1893, pp. 14*).—An account of the introduction and dissemination of Ladoga wheat in the Dominion of Canada and of milling and baking tests of this variety. Ladoga wheat was first introduced into Canada in 1887, and has since been tested by a large number of farmers in different parts of the Dominion. It has been found that this variety can be successfully grown even in the colder regions, and that it ripens at least a week earlier than Red Fife. Analysis shows that it contains a high percentage of gluten, which is, however, "inferior in color and elasticity and more sticky" than that in Red Fife. The flour from Ladoga is drier than that from Red Fife and is not so

easily made into good bread. The color of the bread is usually quite yellow.

Unless the proper methods for treating this flour to procure uniformly good results could be ascertained it is not likely that Ladoga will be acceptable either to millers or bakers as long as the flour of the Red Fife is obtainable. Hence wherever Red Fife can be ripened the efforts of those settlers engaged in wheat-growing in the Northwest should be directed to its production in the greatest perfection by early sowing and a proper preparation of the soil. * * * While the idea of growing Ladoga wheat as a competitor with Red Fife for export or the general home trade should be abandoned, there is no doubt that the flour of the Ladoga makes excellent and nutritious bread for home use, and where wheat-growing is carried on in the more northern districts in a limited way for home consumption, and where Red Fife seldom ripens, or on the Indian reserves, where a yellow tint in the bread is not a matter of so much significance, the Ladoga wheat will still prove a most useful and desirable variety.—A. C. T.

Cherries, J. CRAIG (*Canada Central Experimental Farm Bul. No. 17, Nov., 1892, pp. 20, figs. 9*).—An account of tests of varieties of cherries which give promise of being sufficiently hardy to endure the cold climate of a large part of the Dominion of Canada. A large number of these varieties were originally brought from northern Europe by Prof. Budd, of the Iowa Station, and C. Gibbs, of Abbotsford, Quebec. Suggestions are also made regarding the propagation and grafting of cherries. Descriptive notes are given on the following varieties: Amarelle, Hâtive, Bessarabian, Brusseler Braun, Carnation, Cerise d'Ostheim, Double Glass, Fouches Morello, Frauendorfer Weichsel, Griotte du Nord, Griotte d'Ostheim, Gros Gobet, Griotte Imperiale, Lithauer Weichsel, Lieb, Montmorency, Minnesota Ostheim, Riga No. 18, Orel No. 25, Olivet, Strauss Weichsel, Späte Amarelle, Schatten Amarelle, Vladimir, Weir Seedlings, and Wragg.

"With present experience the following varieties are recommended for trial, and will probably prove valuable in those sections where climatic conditions permit the cultivation of the pear: Amarelle Hâtive, Strauss, Griotte Impériale, Olivet, and Gros Gobet.

"The following list comprises varieties which appear to grade in hardiness with the Wealthy apple: Späte Amarelle, Fouchès Morello, Minnesota Ostheim, Brusseler Braun, and Orel 25.

"Among those of exceptional hardiness, and which should be tested along the northern border of the apple belt are: Riga No. 18, Vladimir, Bessarabian, and Schatten Amarelle."—A. C. T.

Water content of Danish export butter, F. FRIIS (*Nogle oplysninger om "Vand i Smör," Kgl. Veterin. og Landbohöjskoles Laborat. f. landök. Forsög, Circular, Mar. 12, 1893, pp. 4*).—The results of water determinations in 2,091 samples of Danish export butter from 361 creameries and 107 private dairies are given in the circular. The analyses are published to show the absence of adulteration of the butter through an excessive water content, a method of adulteration which Mr. Friis says is moreover excluded for the simple reason that it can not be practiced, except at the expense of the quality of the

butter. The samples were taken from 100-pound butter tubs intended for export; four to five such tubs were procured from each creamery or dairy during the period from June, 1890, to January, 1883, when the analyses were made. The following summary shows the distribution of the percentages of water found in the total number of samples:

Percentages of water in Danish butter.

Water content.	Number of samples.	Per cent of samples.
Per cent.		
19.99–19	2	0.1
18.99–18	21	1.0
17.99–17	88	4.2
16.99–16	218	10.4
15.99–15	418	20.0
14.99–14	583	27.9
13.99–13	464	22.2
12.99–12	235	11.2
11.99–11	57	2.7
10.99–10	4	0.2
9.99–9	1	0.1
14.59	2,091	100

If the water content of the samples received from each creamery or private dairy be averaged, and the average percentages arranged in groups as above, the results will be as follows:

Percentages of water in Danish butter at different factories.

Water content.	Number of factories.	Per cent of factories.
Per cent.		
17.99–17	5	1.1
16.99–16	41	8.8
15.99–15	85	18.2
14.99–14	207	44.2
13.99–13	105	22.4
12.99–12	23	4.9
11.99–11	2	0.4
14.63	468	100

The extremes of the former table here naturally disappear. It will be noticed that Danish export butter from single creameries or private dairies contains on an average between 11 and 18 per cent of water; 85 per cent of the total number fall between 13 and 16 per cent.

"It is evident from this that 13 to 16 per cent must be considered the most correct and natural water content of Danish export butter, and there is scarcely any doubt but what our creameries, by proper manipulation of the butter, in the overwhelming majority of cases are able to keep the water content below 16 per cent on an average for the whole year. But as the quality of the butter usually is lowered when its water content rises above the natural percentage—a relation which later on will be treated in the complete report of this investigation—in the same way a too low water content will often tend to make the butter too dry, or in other respects lower its quality."—F. W. WOLL.

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A study of the results of the association of Streptococcus and typhoid bacillus in man and animals (*Étude sur les résultats de l'association du streptocoque et du bacille typhique chez l'homme et chez les animaux*), H. VINCENT.—*Ann. Inst. Pasteur, 7, No. 2, p. 141.*

A contribution to the study of tetanus, its prevention and treatment by antitoxic serum (*Contribution à l'étude du tétanos, prévention et traitement par le sérum antitoxique*), E. ROUX and L. VAILLARD.—*Ann. Inst. Pasteur, 7, No. 2, p. 65.*

On tuberculosis among cattle and its prevention (*Om tuberkulosen bland nötkreatur och åtgärder mot densamma*), C. A. LINDQUIST.—*Kgl Landtbruks Akad. Handlingar och Tidskrift, 31 (1892), pp. 222–227.*

Experiments with tuberculin (*Forsög med tuberkulin*), B. BANG.—*Kgl. Veterin. og Landbohöjsk. Lab. for landökon. Forsög, Copenhagen, Buls. Nos. 21 and 24, 1890 and 1891, pp. 50.*

On endocarditis among swine (*Undersögelser over nogle former af rödsyge hos svinet*), B. BANG.—*Kgl. Veterin. og Landbohöjsk. Lab. for landökon. Forsög, Copenhagen, Bul. No. 25 (1892), pp. 56.*

The role of flies in the propagation of cholera, J. G. SAWTCHENKO.—*Abst. in Ann. Inst. Pasteur, 7, No. 2, p. 222.*

The preservation of virus in glycerine, A. SCLAVO.—*Abst. in Ann. Inst. Pasteur, 7, No. 2, p. 221.*

On the production of sugar and the sugar industry in Sweden (*Sveriges sockerhandel och sockerindustri; dess utveckling och nuvarande ståndpunkt*), P. KLASON.—*Kgl. Landtbruks Akad. Handlingar och Tidskrift, 31 (1892), pp. 3–39, 65–103.*

On the regulation of wind power and other power machines (*Regulering af vindkraft og andre kraftmaskiner*), P. LA COUR.—*Tidsskr. f. Landökonomie, 11 (1892), pp. 437–468.*

The economical limit for the application of the various motive powers in the service of agriculture (*Den ökonomiske gränse for de forskjellige bevägkräfters anvendelse i landbrugets tjeneste*), H. F. DENCKER.—*Tidsskr. f. Landökonomie, 11 (1892), pp. 338–371.*

Agricultural instruction in Norway (*Landbrugsundervisningens betydning og ordning i Norge*), TH. LANDMARK.—*Åkerbruket och Husdjurskjötseln, 3 (1892), pp. 104–106, 118, 119.*

EXPERIMENT STATION NOTES.

CALIFORNIA STATION.—The olive-oil machinery has been set up and successfully tested, but owing to the short crop of olives no results of work can be published until after another season. In a pamphlet entitled "Methods of detecting adulterants in olive oil," Prof. W. B. Rising, the State analyst, has given a brief description of a number of methods of testing olive oil which he has used, and the tabulated results of tests by these methods. A bulletin giving analyses of California fruits will soon be issued.

COLORADO COLLEGE.—The agricultural hall, a handsome brick structure containing an experimental work room, museum, and lecture hall, has recently been completed, and a mechanics' art hall is in process of erection. In his annual report for 1892, President Ellis urges the necessity for increased accommodations for work in horticulture, botany, chemistry, geology, and domestic economy, and the erection of a gymnasium and dormitories.

MICHIGAN COLLEGE AND STATION.—O. Clute has resigned his position as president of the college and director of the station, to take effect in August.

NEW YORK CORNELL STATION.—L. C. Corbett, B. S., assistant horticulturist, has resigned to become professor of agriculture in the South Dakota Agricultural College and horticulturist to the South Dakota Station. J. E. Rice, B. S., assistant agriculturist, has resigned to engage in fruit and poultry farming, and S. Jeffry, B. S., foreman of the farm, has resigned to become farm superintendent of an industrial school at Asheville, North Carolina.

PENNSYLVANIA COLLEGE.—In his report for 1892 to the board of trustees, President Atherton shows that since 1882 the teaching force has increased from 17 to 30, and the number of students from 92 to 249. Ten officers are now employed in the agricultural department where only one was employed ten years ago. The number of students in the agricultural course continues to be small. One important reason for this is stated to be that in a State like Pennsylvania, where only about 20 per cent of the population are engaged in agriculture, a graduate "finds eight chances for employment outside of agriculture as against only two in it." The author's views on manual labor in connection with educational work are summed up as follows: "As the result of accumulated experience with this subject, I believe there has come to be a general agreement that all manual labor or exercise in connection with education must belong to one or the other of two distinct kinds: It must either be regular labor, carried on at odd hours perhaps, but organized, enforced, and paid for like any other labor, or else it must be so much and only so much as is necessary to train the student to a knowledge of the practical applications of his subjects of theoretical study. In this view the farm, the garden, the stable, and the dairy house become so many laboratories, serving for the student in agriculture the same purpose as is served in other cases by the chemical, the physical, or the mechanical laboratory."

UTAH STATION.—S. Fortier, C. E., has been added to the staff of the station. During the summer he will study the irrigation system of Utah, with a view to devising methods for its improvement.

WYOMING STATION.—B. C. Buffum, horticulturist, will have charge of the Wyoming exhibits in botany and agriculture at the World's Columbian Exposition. The legislature adjourned without taking any action on the removal of the agricultural college to Lander, and it will therefore remain a department of the State University at Laramie.

MECHANICS OF THE EARTH'S ATMOSPHERE.—Under this title the Smithsonian Institution has published a collection of translations by Prof. Cleveland Abbe of "some of the best memoirs that have lately been published on the respective subjects by European investigators."

These memoirs, which fill 324 pages, are as follows: The measurement of the resistances experienced by plane plates when they are moved through the air in a direction normal to their planes, G. H. L. Hagen, 1874; on the integrals of the hydrodynamic equations that represent vortex motions, H. von Helmholtz, 1858; on discontinuous motions in liquids, H. von Helmholtz, 1868; on a theorem relative to movements that are geometrically similar, together with an application to the problem of steering balloons, H. von Helmholtz, 1873; on atmospheric motions, first paper, H. von Helmholtz, 1888; on atmospheric motions, second paper, H. von Helmholtz 1889; on the theory of wind and waves, H. von Helmholtz, 1889; the energy of the billows and the wind, H. von Helmholtz, 1890; the theory of free liquid jets, G. Kirchhoff, 1869; on discontinuous motions in liquids, A. Oberbeck, 1877; the movements of the atmosphere on the earth's surface, A. Oberbeck, 1882; on the Guldberg-Mohn theory of horizontal atmospheric currents, A. Oberbeck, 1882; on the phenomena of motion in the atmosphere, first paper, A. Oberbeck, 1888; on the phenomena of motion in the atmosphere, second paper, A. Oberbeck, 1888; a graphic method of determining the adiabatic changes in the condition of moist air, H. Hertz, 1884; on the thermodynamics of the atmosphere, first paper, W. von Bezold, 1888; on the thermo-dynamics of the atmosphere, second paper, W. von Bezold, 1888; on the thermo-dynamics of the atmosphere, third paper, W. von Bezold, 1889; on the vibrations of the atmosphere, Lord Rayleigh, 1890; on the vibrations of an atmosphere periodically heated, M. Margules, 1890; Laplace's solution of the tidal equations, W. Ferrel, 1890.

THE ANNUAL REPORT OF THE COMMISSIONER OF AGRICULTURE OF ALABAMA for the year ending September 30, 1892, gives a brief outline of the work of the year in fertilizer inspection, distribution of seed, introduction of tobacco, study of destructive insects, and at farmers' institutes; a financial report; and a list of fertilizer licenses.

The department has distributed 128,000 packages of garden seed, and for the purpose of encouraging diversification of crops, so desirable in the State, 12,000 packages of improved varieties of tobacco. "This year's effort has indisputably proved that Alabama possesses all the qualifications necessary to the profitable production of tobacco—climate, soil, and seasons; and we make the prediction that in less than a decade Alabama will become a factor in the line of tobacco-raising States."

AGRICULTURE IN THE PUBLIC SCHOOLS.—A special bulletin on the Teaching of Agriculture in the Public Schools, by C. C. James, M. A., deputy minister of agriculture, was issued in December, 1892, by the Department of Agriculture of Ontario, Canada.

OBSERVATIONS ON TILE DRAINAGE.—This office is in receipt of an interesting communication from H. C. Marsh, Muncie, Indiana, briefly describing experiments in tile drainage made under the auspices of the Farmers' Institute of that place. Three tile drains were laid, about 40 inches deep and at distances of 195 and 230 feet apart, on an area containing yellow clay, black soil, and hardpan. The height of the ground water was observed in wells sunk in different parts of the drained area.

The results are of interest as showing a wide difference in the effectiveness of the drains on different soils and under different conditions, and indicate that the distance and depth of tile drains must be determined by observations on the soils in each case.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

FEBRUARY, 1893.

BUREAU OF ANIMAL INDUSTRY:

Bulletin No. 2.—Report on Investigations Relating to the Treatment of Lumpy Jaw or Actinomycosis in Cattle.

DIVISION OF STATISTICS:

Report No. 101 (new series), January and February, 1893.—Agriculture in France; Report on Hungarian Milling; The Canning Industry; Tobacco Experiments in Texas; European Crop Report for February; Farm Animals of the World; Freight Rates of Transportation Companies.

Report on the Numbers and Values of Farm Animals and on Cotton Distribution, January and February, 1893.

DIVISION OF ORNITHOLOGY AND MAMMALOGY:

Bulletin No. 3.—The Hawks and Owls of the United States.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. IV, No. 6, January, 1893.

WEATHER BUREAU:

Bulletin No. 7.—Report of the First Annual Meeting of the American Association of State Weather Service.

Monthly Weather Review, vol. XX, November, 1892.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

FEBRUARY, 1893.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 40, January, 1893.—Cotton Experiments.

COLORADO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 21, October, 1892.—Sugar Beets, Irish Potatoes; Fruit-Raising.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF IDAHO:

Bulletin No. 1, September, 1892.—Organization and Progress of Work at the Experiment Station.

IOWA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 19, November, 1892.—Experiments with New Orchard Fruits, Trees, and Plants; Report of Experiments and Studies in Entomology; Crossing Cucurbits; Root Crops; Corn-growing; Depth of Covering Grass Seed; Winter Wheat; Calf-feeding; Hog-feeding; Soiling Crops; Hints on Cheese-making; An Automatic Acid Measure.

KANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 35, December, 1892.—Actinomycosis Bovis or Lump Jaw of Cattle.

Bulletin No. 36, December, 1892.—Experiments with Sorghum and Sugar Beets.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 43, December, 1892.—Commercial Fertilizers.

Bulletin No. 44, January, 1893.—Bordeaux Mixture for Apple Pests.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 19, December, 1892.—Tomatoes.

Fifth Annual Report, 1892.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL STATION:

Bulletin No. 20, January, 1893.—Reports on Insects.

Meteorological Bulletin No. 49, January, 1893.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 22, September, 1892.—Grapes.

Fifth Annual Report, 1892.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 48 (new series), December, 1892.—Some Bean Diseases.

Bulletin No. 49 (new series), January, 1893.—Treatment of Potato Scab; Use of Bordeaux Mixture for Potato Blight.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 87, September 15, 1892.—Publications of the Station from March, 1877, to September, 1892.

Bulletin No. 87*b*, September 20, 1892.—Meteorological Summary for North Carolina, August, 1892.

Bulletin No. 87*c*, October 20, 1892.—Meteorological Summary for North Carolina, September, 1892.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION—Continued.

Bulletin No. 88*a*, January 20, 1893.—Meteorological Summary for North Carolina, December, 1892.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Fifth Annual Report, 1892.

TEXAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 23, November, 1892.—Black Rot of the Grape.

Bulletin No. 24, December, 1892.—The Cattle Tick.

VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE EXPERIMENT STATION:

Bulletin No. 23, December, 1892.—Tests of Fertilizers on Corn.

Annual Report, 1892.

WYOMING AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 9, December, 1892.—Sugar Beets in 1892.

Bulletin No. 10, December 31, 1892.—Meteorology for 1892.

DOMINION OF CANADA.

ONTARIO AGRICULTURAL COLLEGE EXPERIMENT STATION:

Bulletin No. 86, February 1, 1893.—Roots, Potatoes, and Fodder Corn.

Special Bulletin, February, 1893.—The Making of Roads.

EXPERIMENT STATION RECORD.

VOL. IV. APRIL, 1893. No. 9.

The present number of the Record contains an article on agricultural education in Belgium, by Paul De Vuyst, State agriculturist connected with the Ministry of Agriculture of that country. Belgium, we should remember, is the most densely populated country in Europe. Within an area which does not exceed that of Massachusetts and Connecticut is crowded a population as large as that in the State of New York. About three fourths of the people live in the rural districts. Of the total area of about 7,000,000 acres, less than 500,000 acres are waste land. While the manufacturing interests of this little kingdom are very important, its prosperity very largely depends on its agriculture. It can be easily understood that in these times, when the conditions of successful farming are so rapidly changing, a country like Belgium would feel the necessity of giving its agricultural classes the best opportunities for acquiring such mental training and technical information as can be imparted by a thorough system of education arranged with special reference to the practical needs of farmers. The system as outlined in the article referred to includes 4 schools for higher education, 24 secondary schools for boys, and 9 for girls, 40 short courses in agriculture in secondary schools, numerous courses in agriculture in the normal and primary schools, and lectures to farmers and to soldiers. The difference is very striking between this system and that in the United States, where one or two agricultural colleges, supplemented in some cases by farmers' institutes, in each State, whether large or small, are all the provisions which the people have thus far thought best to make for the special training of farmers. The Belgian plan contains one feature which may suggest a way for extending the facilities for agricultural education in this country with a minimum of additional expense. The Belgian authorities have added to the schools for general education already existing such courses in agriculture as seemed desirable, and given out of the public treasury the relatively small amounts of money required for the additional instruction. In a similar way it would be possible in many of our States

to establish courses in agriculture in connection with the high schools or academies now in operation at the county seats. A plan like this has been adopted in some States for raising the grade of teachers in the rural schools. Teachers' classes have been formed in the high schools and the State has paid the extra expense involved in this arrangement.

In Belgium, as in other European countries, education in agriculture has even penetrated the elementary schools. In this country we are still debating whether it is practicable to give any technical training in the common schools. In a number of our cities some instruction in carpentry, sewing, and cooking is now given in the public schools, but there has hardly been a serious attempt to introduce agriculture into the rural schools. Indeed, comparatively few efforts have been made in our country schools to train the pupils in those habits of observing natural objects and phenomena which lie at the foundation of all successful work in the arts and sciences.

By a resolution of the United States Senate the Department of State was requested to obtain information regarding the use of electricity as a power in the propulsion of farm machinery and in the propagation of plants in the various countries of the world. The results of this inquiry are given in Consular Report No. 150, March, 1893, pages 321–361. As far as this report shows, it would appear that very little practical use has been made of electric motors in running farm machinery. Only two instances are definitely cited. At Chassart, Belgium, the owner of a large establishment, which consists of grain silos, mills, distillery, malt house, brewery, sugar works, refinery, and farm, has employed electricity as a motive power in various ways, and in particular has transmitted the power a distance of about 800 meters to run a threshing machine of about 12-horse power. At Blythwood, England, a dairy for the making of "gilt-edged" butter is lighted by electricity, which is also used to run the separators and churns.

The experiments in the application of electricity to the propagation of plants have been almost entirely confined to those scientific investigations regarding which information has already been widely disseminated in this country through the publications of Prof. Bailey, of New York, and Prof. Warner, of Massachusetts, abstracted in earlier numbers of the Record. (See Bulletins Nos. 30 and 42 of the New York Cornell Station, and Bulletin No. 16, of the Massachusetts Hatch Station; E. S. R., vol. III, pp. 232 and 517; IV, p. 349.)

AGRICULTURAL EDUCATION IN BELGIUM.

PAUL DE VUYST.

Until 1884 the public authorities in Belgium had not given agricultural education the attention which its importance demanded. But when the condition of agricultural affairs had become very much disturbed, a Ministry of Agriculture was established. This department at once undertook to restore the prosperity of the country by organizing, for the instruction of the farmers in the advanced knowledge given by science, a system of education as complete and thorough as that afforded by any other nation. If the present system of agricultural education in Belgium is not well understood by foreigners, it must be because of its recent introduction and because the country is so small that its institutions do not readily attract the notice of the world. The credit for taking the initiative in the establishment of the system belongs to Mr. Proost, Inspector-General of Agriculture.

Up to 1890 agricultural education was regulated by the law of June 11, 1850, on veterinary instruction, and the law of July, 1860, on agricultural instruction. These laws did not give the Government sufficient latitude to enable it to raise the courses of instruction in existing schools to the grade demanded by agricultural science and to increase the number of schools in accordance with the actual needs of the people. But on April 4, 1890, two new laws were enacted, which took the place of the old ones and permitted the establishment of the complete system of agricultural education now in operation.

The following synopsis gives the general outlines of this system:

HIGHER EDUCATION IN AGRICULTURE.

General.—(*a*) Supported by the State; Agricultural Institute of Gembloux.
(*b*) Private; Agricultural Institute of Louvain.

Special.—(*a*) Supported by the State; School of Veterinary Medicine at Cureghem.
(*b*) Private; School of Brewery at Louvain.

SECONDARY EDUCATION IN AGRICULTURE.

FOR YOUNG MEN.

General.—(1) With a complete course in agriculture.
(*a*) Supported by the State; Schools of Practical Agriculture at Huy, Ghent, and Vilvorde.
(*b*) Private, but subsidized by the State; fourteen schools in different districts.
(2) With a general course in agriculture.
(*a*) Supported by the State; thirty intermediate schools.
(*b*) Private; ten intermediate schools.

Special.—(*a*) Supported by the State; Schools of Horticulture at Ghent and Vilvorde.
(*b*) Private, but subsidized; five schools of horticulture.

FOR YOUNG WOMEN.

General.—(1) With a complete course; five schools of agriculture, subsidized.
(2) Courses in private schools; three schools.

Special.—One permanent school and two traveling schools of dairying and cheese-making at Wevelghem, subsidized.

PRIMARY EDUCATION IN AGRICULTURE.

General.—(1) For adults.
(*a*) Two hundred and fifty one-year courses of fifteen lessons for farmers.
(*b*) Five courses for soldiers.
(*c*) Lectures by the State agriculturists.
(2) Courses in the normal schools, whether under State control or not.
(3) Courses in the primary schools, whether under State control or not.

Special.—(*a*) Demonstrative courses in dairying.
(*b*) Courses and lectures on horticulture, culture of garden vegetables, agriculture, pisciculture, etc.

This synopsis will enable those who are already somewhat familiar with matters relating to agricultural education to understand what is being done in that line in Belgium without a more detailed presentation of the subject. Thus it is hardly necessary to explain that a superior school of agriculture trains competent agriculturists, teachers, etc., or that the intermediate courses are intended for the average farmers and for younger pupils than are found in the higher schools.

When we speak of general instruction in agriculture we include all branches of agriculture, and when a school is called "practical" the meaning is that it devotes a relatively large share of attention to the application of the principles of scientific agriculture by means of labor and other practical exercises. Moreover, some of our schools are organized on models so well known abroad that we need not describe them. We will, therefore, only mention here those characteristic features which distinguish the system of agricultural education in Belgium and the institutions established under it.

HIGHER INSTRUCTION IN AGRICULTURE.

The Agricultural Institute of Gembloux.—This institution is luxuriously installed in large buildings. Founded many years ago, it is enriched with accumulated collections. It would be difficult to find an institution possessing so many materials which are of service in the higher instruction. Its regulations and courses of study do not present any striking peculiarities. Like similar courses in institutions of high grade, those of Gembloux are very complete. Its system of instruction, formed on the pattern of that of the Agricultural Academy of Hohenheim, has been modified in recent years to make it more scientific and more like that followed in the universities. A larger number

of professors are employed, and the methods of teaching have been somewhat changed. The professors have more time to devote to special lines of work and can give their pupils more opportunities for the practical application of the principles taught. A large farm is connected with the institute, and if the theoretical studies absorb so much of the time of the pupils that they can not be initiated into all the details of farm practice during their residence at the school, the farm nevertheless renders the theoretical instruction more objective and helps to imbue the pupils more definitely with the agricultural spirit through the influence of their surroundings.

The Agricultural Institute of Louvain.—As a branch of the scientific faculty of the university, this institution naturally has a course of instruction which is more completely of university grade—or, in other words, more scientific—than that offered at Gembloux. The institute at Louvain has at its disposal all the scientific resources of the university, but does not possess a farm. The advantages which would be offered by a farm attached to the institution are made up by numerous and varied excursions to different localities.

The School of Veterinary Medicine of Cureghem, Brussels.—This school has recently been raised in grade by the Government. To be admitted to the course which leads to a degree in veterinary medicine it is now necessary to first obtain the same university diploma which is required of the candidate in human medicine. On account of the great importance which the study of bacteriology has now acquired, a special chair in this science was established at the same time that the other changes referred to were made. Although the buildings of the school were sufficient, especially after the abolition of boarding facilities for the students, the Government has undertaken to provide more convenient quarters near a slaughterhouse and a cattle market, which will afford better opportunities for practical exercises.

SECONDARY INSTRUCTION IN AGRICULTURE.

The Schools of Practical Agriculture at Huy, Vilvorde, and Ghent.—The school at Huy is exclusively devoted to instruction in agriculture, while the similar institutions at Vilvorde and Ghent are at the same time schools of horticulture, special attention being given to this branch. These schools are exclusively under the control of the national Government, though the province pays a portion of the expenses of the school at Huy.

Private schools with subsidies from the Government.—Private schools in various places receive small subsidies from the Government to aid them in organizing agricultural courses. As these schools are of different kinds, the Government has arranged three different courses of instruction from which a choice can be made according to the requirements of the individual school. These courses resemble the typical courses of the State schools of practical agriculture. But as the system

of indoor discipline in most private schools does not permit sufficient time to be given to the practice of agriculture, the Government contents itself with requiring appropriate theoretical instruction.

As the results of instruction depend on the methods of teaching much more than on the subjects included in the course of study, the Government has given definite instructions to the secondary schools of agriculture to the end that their teaching may be as intuitive as possible. Since agriculture is an art which derives advantage from the sciences of observation, it is important that the schools of agriculture should give the place of honor to the intuitive method of teaching. It was especially desirable to strenuously insist on the necessity for the adoption of this method in the private institutions, because the studies pursued there are as a rule literary and require too exclusive exercise of the memory.

The secondary schools of agriculture are located so as to meet as equally as practicable the needs of the different agricultural regions of Belgium. They have been called upon to make themselves useful to the farmers of their respective localities by every means, but particularly by studying methodically the soil of the surrounding lands, by publishing the results of their experiments, etc.

The department of agriculture proposes to issue an agricultural chart of the Kingdom. This chart is to be prepared by the coöperative labor of the geologists and agriculturists in the agricultural institutions. The former will furnish the geological and hydrological data; the latter will give the meteorological and agricultural data. The agricultural information will include the chemical analysis of the soil as well as its "physiological" analysis, *i. e.*, analysis based on plants grown in pots or in the field. Three schools have taken the initiative in this line of work, and the department is counting on the cordial assistance of the entire service of agricultural institutions to enable it to bring this chart to a rapid completion.

Courses in agriculture in the State and private secondary schools.—The Ministry of Agriculture does not content itself with the establishment of schools which are exclusively devoted to agricultural education, but it also endeavors to introduce agricultural features into the institutions for general education. Thus it is that thirty courses in agriculture, consisting of one lesson each week, are given in secondary schools supported by the Government, and ten courses in private schools of the same grade.

Schools of horticulture.—The State schools of horticulture at Ghent and Vilvorde have acquired a certain dignity due to their age and have an established reputation abroad. The private schools of horticulture subsidized by the State are of more recent origin. The most eminent of these is located in the city of Tournay.

Schools of agriculture for young women.—It is only very recently that it has been seen that it is important for the agricultural prosperity

of a country to train competent farm women as well as farm men. After having conducted an inquiry, under the direction of the author, into what had been accomplished in this line in other countries, the department of agriculture aided with subsidies the establishment of the schools for young women at Virton, Brugelette, Bouchout, and Gyseghem. It is the purpose before long to have one such school for each province. The course of study in these schools embraces all the theoretical and practical subjects that a competent farm woman should be acquainted with, including dairying, domestic economy, kitchen gardening, etc.

Courses in agriculture in other schools for young women.—The Government is seeking to widely extend instruction in agriculture and dairying by giving subsidies for the organization of courses which include three or four lessons a week and a few hours of practice.

Schools of dairying and cheese-making.—For special theoretical and practical instruction in dairying there is a permanent school at Wevelghem. This school is installed on a large farm. Its course of study extends over three months. There are, besides, two itinerant dairy schools which move from farm to farm. Their course of study is identical with that of the permanent school. These schools are well equipped with the necessary apparatus. They exercise considerable influence on the progress of the dairy industry in Belgium.

PRIMARY INSTRUCTION IN AGRICULTURE.

Course in agriculture for adults.—Each year more than 200 courses in agriculture are given in the different rural districts of the country. These courses consist of 15 lectures on questions of general interest to farmers. They are delivered by agricultural engineers, agriculturists, and teachers who are thoroughly competent for this kind of work. To secure practice in this exceedingly difficult kind of teaching, the persons appointed to give these courses meet together twice a year in each district. At these meetings one of their number presents a typical lecture, and the others discuss it. The best lessons in the different courses are printed and distributed. At these meetings the improvements which are most urgently needed by the farmers of the region are also studied.

This method of organized courses of instruction in agriculture for adults is, we believe, peculiar to Belgium. The results which it has produced during four years are quite important. There are in the Kingdom about 2,500 rural communes. Within a few years no locality will have reason to complain that it has not enjoyed the advantages of this institution. The courses are attended each year by more than 10,000 farmers. The expense of conducting them amounts to only about $1 per hearer.

Course in agriculture for soldiers.—In Europe military service takes away a very large number of young men from agricultural pursuits.

In Belgium an attempt is made to remedy this mistake in part by giving the sons of farmers in five garrisons instruction in agriculture during the years of their military service.

Lectures by State agriculturists.—A corps of nine State agriculturists and ten assistant agriculturists residing in the provinces is charged with disseminating agricultural information by the establishment of experimental fields and by numerous lectures.

Courses in agriculture in the normal schools and for teachers on duty.—In order to introduce instruction in agricultural science in the primary schools, it was necessary to train teachers. For this purpose the Ministry of the Interior and of Public Instruction reorganized the course of study in the normal schools so as to give considerable attention to agriculture. For the teachers on duty who had not had the opportunity of acquiring such knowledge when they were at the normal school, the Ministry conducts, each year, temporary courses, by pursuing which these teachers can secure a certificate of competency in this branch of instruction.

Courses in agriculture in the primary schools.—Belgium is one of the countries in which primary education is very thoroughly organized. Within the last few years the Ministry of the Interior and of Public Instruction has formulated detailed instructions with a view to giving a much greater development to the teaching of agriculture in the primary schools of the rural communes. From a pedagogical point of view these instructions are quite remarkable. Their author is Mr. Germain, Director-General of Primary Education.

Demonstrative courses in dairying.—Each year the department of agriculture organizes courses in dairying for six days or more, in which able dairywomen give practical demonstrations on the making of butter and cheese according to the most advanced methods. These demonstrations are extraordinarily well attended and contribute much to the progress of the dairy industry.

Courses and lectures on various special topics.—These have special reference to horticulture, kitchen gardening, zoötechnics, horseshoeing, apiculture, viticulture, etc.

Such is an outline of our system of agricultural instruction, strictly speaking, *i. e.*, the instruction imparted by the teacher to the pupil. Every three years, in conformity with the law, the Honorable Minister of Agriculture makes a report on the condition of this instruction. The last triennial report for the years 1888–'90 formally declares that great progress has been made over the work of previous years.

Besides the direct instruction, the organization of which we have set forth, a great number of institutions have a share in the agricultural education of the farmers by other means. Such are the agricultural societies, the laboratories for analysis, the agricultural newspapers, etc.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

METEOROLOGY.

Weather report for 1892, J. G. LEE (*Louisiana Stas. Bul. No. 21, 2d ser., p. 656*).—The maximum, minimum, and average temperature of the air, and the rainfall by months are tabulated.

Meteorological observations at Massachusetts Hatch Station, C. D. WARNER (*Massachusetts Hatch Sta. Met. Buls. Nos. 49, 50, 51, and 52, Jan., Feb., Mar., and Apr., 1893, pp. 4 each*).—Daily and monthly summaries of observations for January, February, March, and April, 1893, at the meteorological observatory of the station.

Meteorological summaries for North Carolina for July, August, September, October, November, and December, 1892, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Buls. Nos. 87a, Aug. 20, 1892, pp. 16; 87b, Sept. 20, 1892, pp. 15; 87c, Oct. 20, 1892, pp. 15; 87e, Nov. 28, 1892, pp. 16; 87f, Dec. 20, 1892, pp. 15; and 88a, Jan. 20, 1893, pp. 15*).—Notes on the weather and tabulated daily and monthly summaries of observations by the North Carolina weather service coöperating with the U. S. Weather Bureau.

Meteorological summaries for North Carolina for January and February, 1893, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Buls. Nos. 88d and 89b, March 1 and March 20, 1893, pp. 16 and 15, maps 2*).—Notes on the weather and tabulated daily and monthly summaries of observations by the North Carolina weather service coöperating with the U. S. Weather Bureau. Maps show the isothermal lines and normal precipitation.

Meteorology of Wyoming for 1892, B. C. BUFFUM (*Wyoming Sta. Bul. No. 10, Dec., 1892, pp. 60*).—This bulletin "is a full report on the climate of the State for 1892 as observed by the experiment station," and includes detailed tabulated data and summaries of observations on evaporation (from a water surface), temperature, terrestrial radiation, saturation of the air and temperature of the dew-point, precipitation, soil temperatures, atmospheric pressure, and movement and velocity of wind at the station at Laramie; on temperatures, saturation of air and temperature of dew-point, and precipitation at the substation at Lander; and on temperatures and precipitation at the substations at Saratoga, Sheridan, Sundance, and Wheatland. In addition, summaries of observations by voluntary observers in different parts of the State are

tabulated. The summary for the year is as follows: *Air temperature* (degrees F.).—Highest 109, at Wheatland, July 21; lowest—46, at Sheridan, January 11; highest annual mean 49.2, at Wheatland; lowest annual mean 40.5, at Laramie; average annual mean for six stations 43.1; greatest daily range 57, at Lander, December 22, and at Wheatland, March 17; greatest annual mean daily range 29.4, at Wheatland; lowest annual mean daily range 22.6, at Sundance; average annual mean daily range for the six stations 26.7. *Precipitation.*—Greatest annual 24.69 inches, at Sundance; lowest annual 8.91 inches, at Saratoga; average annual for 1892 for the six stations 14.84 inches.

Notes on climate.—Differences in altitude and exposure cause a diversity of climate in the different parts of the State treated in this bulletin. With the exception, perhaps, of the extreme southwestern portion and the Big Horn Basin, all portions of the State are well represented by the six experiment farms. It is probable, therefore, that the average annual mean temperature given in the general summary for 1892 is near the mean temperature for the whole State.

The amount of precipitation varying so greatly in different localities, the average annual precepitation given can not be relied upon as the average rainfall for the State. There are large areas over which the rainfall is less than in several of the places named, which would decrease the general average.

As in other parts of the arid region, the climate of the State is characterized by comparatively few stormy days and a large amount of sunshine; the air is dry, giving low relative humidities and dew-points.

The southern and western parts of the State are at high altitudes—from 5,500 feet to over 7,000 feet. The mean annual temperature is correspondingly lower, but the cold is not more intense in winter than at lower altitudes. On these high plateaus, which are not sheltered by mountains, there is a large amount of wind, as indicated by the observations at Laramie, though the amount is not as great as in eastern Kansas.

On still, clear nights the terrestrial radiation is great, which may cause light frosts late and early in the season.

In general, the climate is favorable to the production of hay, the cereals, flax, root crops, strawberries, and other hardy small fruits, while in sheltered positions the more hardy orchard fruits are successfully grown.

In the eastern, central, and northern portions the altitude is lower—from 5,500 feet to 3,500 feet. The growing season is longer and climate favorable to all crops grown in adjoining States. In the northeastern portion crops are matured without irrigation, though drouth is sometimes felt when the rainfall is not distributed through the growing season. The spring of 1892 was remarkable for the large amount of precipitation, giving crops and grass an early start and good growth.

SOILS.

W. H. BEAL, *Editor.*

Terrestrial radiation and soil temperatures, B. C. BUFFUM (*Wyoming Sta. Bul. No. 10, Dec., 1892, pp. 11, 17*).—Tabulated daily and monthly summaries of observations on terrestrial radiation and weekly means of soil temperatures in irrigated ground.

Some soil analyses, G. L. HOLTER and J. C. NEAL (*Oklahoma Sta. Bul. No. 5, Jan., 1893, pp. 16*).—This is a report of analyses of three soils with their subsoils, which "may be regarded as typical for the

part of Oklahoma in which the experiment station is located." This report is stated to be merely preliminary to an extended examination of the soils of the Territory.

The general contour of this section is that of a very undulating surface; terraces, hill upon hill, ancient water levels, inclosing shallow basins, evidently formed by the juncture of creeks and rivers.

Isolated tower-like masses of sand rock occasionally occur, though generally the rock crops out at the highest points, or forms broad shelves at the bases of the clay hills.

The streams are as a rule narrow, rapid, and exceedingly crooked, with very steep banks. The alluvial "first bottoms" are subject to overflows when the heavy rains of spring and autumn occur, every gorge or "draw" becoming a torrent for a few hours.

These "bottoms" are often heavily timbered with pecan, oaks, hickory, walnut, ash, redbud, and cottonwood, with occasionally an elm or box elder. The undergrowth is sumach, dogwood, elder, haw, and wild plum, with green briar and wild grapevines.

The second, third, and fourth plateaus are fairly good farming lands, loamy or gravelly, occasionally with beds of waterworn pebbles, marking an ancient stream whose muddy current brought these fragments from regions further west and north and left them in the eddy at the base of the terrace bank, while "black jack" clay ridges show the deposit of quieter waters perhaps at the same time.

But little is known of the minerals of this region; limonite, iron ore, is found in great masses on the surface near the station, and crystalized gypsum is very plentiful. * * *

The botany of this part of the Territory has not been well studied, and details can not yet be given. The common grasses are: blue stem and blue joint (*Agropyrum*), grama and bunch grass (*Bouteloua* and *Buchloe*), bent grass (*Agrostis*), panic grass (*Panicum*), dropseed (*Sporobolus* and *Muhlenbergia*), reed grass (*Deyeuxia*), meadow grass (*Poa*), and poverty grass (*Aristida*).

These furnish a thin covering for the soil except in the damp draws or arroyos, but in no place do they furnish a good sod or sward. * * *

The occurrence of vast quantities of gypsum, the alkali spots, and the great amount of soda, as shown by analysis, is proof that this section once was the bed of an inland ocean.

Analyses of the different samples of soils gave the following results:

Analyses of Oklahoma soils.

	Upland.		Alluvial.			Clay ridge.		Alkali.
	Soil.	Subsoil 1–3 feet.	Soil.	Subsoil to 2 feet.	Subsoil to 3 feet.	Soil,	Subsoil 1–3 feet.	Soil.
	Pr. ct.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Fine earth*	36.87	2.48	42.85	23.42	32.92	41.38	5.16	16.29
Coarse material	63.13	97.52	57.15	76.88	67.08	58.62	94.84	83.71
Water and volatile matter	4.10	2.92	3.69	1.82	2.18	2.06	2.39	1.96
Soluble silica	7.76	13.10	5.65	7.95	7.68	4.47	14.91	6.00
Insoluble silica	79.99	70.52	84.97	81.98	81.77	87.91	65.13	82.87
Lime (Ca O)	0.95	0.86	0.44	0.27	0.32	0.76	1.75	1.06
Magnesia (Mg O)	0.21	0.26	0.16	0.12	0.18	0.18	0.26	0.06
Soda (Na_2 O)	0.31	0.33	0.48	0.88	0.39	0.36	0.44	0.69
Potash (K_2 O)	0.44	0.45	0.80	0.76	1.21	0.32	0.33	0.52
Manganese (Mn_3 O_4)	0.07	0.08	0.03	0.06	0.03	0.06	0.11	0.07
Iron oxide (Fe_2 O_3)	3.40	4.31	2.71	3.11	3.07	2.80	4.92	3.64
Alumina (Al_2 O_3)	2 78	7.33	1.42	3.32	3.33	1.05	9.09	4.06
Sulphuric acid (SO_3)	0.15	0.11	....	....	....	0.16	0.04	0.03
Phosphoric acid (P_2 O_5)	0.06	0.04	0.04	0.11	0.05	0.06	0.81	....
Humus	0.51	0.20	0.62	0.69	1.54	0.51	0.53	0.62

*Passed 0.5 mm. mesh seive.

[Taking the figures of Hilgard for composition of a good soil] as correct, even our poorest lands stand well. The weak points are easily supplied by phosphate and gypsum, and the most costly ingredient, potash, is in quantity to endure a generation or so.

Chemical composition of Texas soils, H. H. HARRINGTON (*Texas Sta. Bul. No. 25, Dec., 1892, pp. 16*).—The practical benefit to be derived from analysis of the soils is briefly discussed, and directions for sampling are given.

A rough general classification of the soils of the State is described as follows:

The coast belt.—Under this head we place two divisions as classified geologically by E. T. Dumble, State Geologist: The coast clays proper and the soils of the Fayette beds. The coast clays comprise a prairie region 50 to 100 miles inland from the coast, the surface of the country being generally very level, in many places too much so for proper drainage. The soil is a dark sandy loam (prairie) usually; but in many places is almost "black waxy", containing an abundance of lime and clay. The subsoil is clay, usually red or yellow. Almost the entire area is susceptible of cultivation and some of it very fertile. The district is given up mostly to cattle raising; but in certain localities very fine farms are maintained. It is well adapted to fruit, and the Alvin and Hitchcock localities are acquiring a wide reputation in this respect. Corn, cotton, oats, sorghum, sugar cane, and rice are the leading field crops. Joining the coast prairies on the north there is a belt of black sandy soil, giving way in some places to a sandy loam that is very fertile.

The East Texas belt.—The soils of this division vary very widely in composition, the timber growth itself being widely different in character; the vast body of timber in the southern part being long-leaf pine, but on the western border especially this gives way to post oak, black jack, sweet gum, and hickory, intermixed with other varieties of oak, sweet gum, and cottonwood. The upland soil of the pine region is gray sand usually; not different from the same soil occurring in the pine belts of the older Gulf States. It is almost pure sand, as shown by analysis. * * * Of course such a soil can have very little fertility; but the lowlands, valleys, and alluvial soils are in many places very fertile. * * * The hillsides also frequently embrace a sandy loam rich in vegetable matter and underlaid by clay. This soil produces well and is generally easily cultivated.

The Black Prairie belt.—There are four divisions of this with only slight variations. The first on the east, next to the timber belt, is distinguished by the presence of sand in the soil—with occasional pure beds of sand—illustrated by the analysis of soil samples from Terrell and Pecan Gap. West of this strip comes the main black-waxy area, characterized by a substructure of light blue or yellow calcareous clay, called by the residents "soapstone" and "joint clay," from its laminated structure. Small depressions in the surface of the soil, called "hogwallows," are quite common. These are caused by the unequal drying and expansion of the calcareous clays in poorly drained places.

Fort Worth Prairie belt.—This extends across the State immediately west of the Black Prairie, and parallel with it. The soils, except in the valleys, are generally shallow and rocky, tending to a yellow or chocolate brown in color. No samples of soils from this locality have been collected.

The Pan Handle soils.—This includes the Pan Handle proper, and much of what is known as the "arid portions" of the State. The Pan Handle is the grain-producing portion of the State—wheat, oats, barley, and rye. The amount of rainfall is limited, varying from five inches to thirty inches. In some localities the rainfall is sufficient for the maturity of corn, cotton, and sorghum. It is devoted principally to stock raising, the native mesquite grass affording good pasturage in summer and drying in winter where it grows. There is not sufficient rain at this season to destroy its nutritive value. * * *

The alluvial soils.—It is impossible to treat fairly of Texas alluvial soils. From the black hammock of the smallest stream to the chocolate loam of the Brazos there is every possible variety, all vieing with each other in fertility; a richness that is annually increased in many instances by inundation from the streams. But while

much of this land is subject to overflow, this overflow comes at a time not to seriously interfere with growing crops, or can be easily and safely leveed. Perhaps the richest type of Texas alluvial soil is that of the Brazos, a valley 300 miles in length, from Waco to the Gulf, averaging 4 miles in width. It comprises a body of land not surpassed for fertility and endurance in the State, and that will compare favorably with the richest alluvial land in the world. Much of it is annually inundated with water, carrying silt that is itself almost a commercial fertilizer. Indeed the whole river valley is made of a soil similar in composition to this silt, for fifty feet of the same general character. * * *

The Brazos bottom perhaps may be said to carry three distinct types of soil: One is the chocolate loam already mentioned, the most common type. Then a sandy loam, sometimes giving way to almost pure sand. The third type is a black soil, "peach ridge," as it is called, from the characteristic growth of the wild peach. The Brazos soil is not difficult to cultivate, gives itself good natural drainage, and is adapted to a great variety of crops, the only difficulty being that small grain grows too heavy, and falls down usually before ripe enough for harvesting. Compared to the growth along the rivers in the other Gulf States, the timber is light and the ground easily put in cultivation.

Analyses by D. Adriance and P. S. Tilson of soils and subsoils from some of these areas, as well as of samples of clay from the college grounds, and of a supposed phosphate rock, are given in the following table:

Analyses of Texas soils and corresponding subsoils.

Locality.	Moisture.	Volatile and organic matter.	Insoluble matter and sand.	Iron oxide.	Aluminum oxide.	Calcium oxide.	Magnesium oxide.	Sulphuric acid.	Phosphoric acid.	Potash.	Soda.	Carbon dioxide.
The East Texas belt.												
Cherokee County, Rusk	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr ct.*	*Pr. ct.*
Valley soil	1.32	4.60	83.22	5.82	2.11	0.555	0.126	......	0.243	0 48	0.40	0.44
Subsoil	1.02	3.31	85.91	6.44	1.71	0.255	0.197	......	0.141	0.442	0.486	0.187
Ridge soil	0.42	1.96	95.25	1.22	0.69	0.16	Trace	Trace	0.07	Trace	Trace	......
Subsoil	0.30	0 92	96.38	1.18	0.66	Trace	0.18	0.10	0.15	Trace	Trace	......
Pine ridge	0.80	2.05	96.21	0.776	......	......	......	Trace	Trace	Trace	Trace	0.34
Subsoil	0.40	0 73	97.76	0.92	0 009	......	......	Trace	Trace	Trace	Trace	0.21
Tyler County creek bottom	2.30	3.22	89.49	3.94		0.44	0.08	Trace	0.03	0.06	0.07	......
Subsoil	1.77	2.56	91.09	4.12		0.36	0.15	Trace	0.03	0.12	0.16	......
Tyler County upland soil.	0 37	1.18	97.58	0 75		......	0 08	Trace	Trace	Trace	Trace	......
Subsoil	0.30	0.67	98.17	0.78		......	......	Trace	Trace	Trace	Trace	......
The Black Prairie belt.												
Pecan Gap prairie	6.34	7.88	68.06	4.23	9.48	0.814	0.32	0.236	0.128	0.83	0.636	0.344
Subsoil	7.568	6.668	62.91	4.19	10.36	0.305	0.34	0.12	0.179	1.29	0.60	2.32
Terrell prairie	2.09	6.84	85.96	1.08	1.68	0.55	0.28	0.24	0.28	0.17	0.07	......
Subsoil	2.09	3.81	87.95	1.45	2.71	0.37	0.32	0.11	0.23	0.27		......
Kaufman hammock	7.91	6.92	62.98	2.86	7.35	6.30	0.46	0.147	0.25	0.68	0.09	4.91
Subsoil	7.70	6.16	62.84	2.74	8.18	6.74	0.297	0.216	0.499	0.39	0.20	4.48
Kaufman County timber land	4.56	6.03	60.55	2.42	4.53	11.00	0.543	0.127	0.326	0.316	0.128	8.49
Subsoil	4.36	7.42	60.96	2.27	5.59	10.05	0.64	0.16	0.266	0.419	0.185	7.78
Kaufman prairie soil	7.57	11.06	56.50	2.82	7.04	6.62	0.81	0.151	0.313	0.837	0.052	6.26
Subsoil	6.78	10.96	56.40	2.78	2.38	7.35	0.615	0.137	0.294	0.606	0.109	6.06
Manor	8.47	7.26	50.09	3.73	10.35	5.81	0.317	0.082	0.115	0.576	0.151	5.84
Subsoil	8.23	7.18	51.17	4.74	14.33	6.96	0.507	0.147	0.179	0.604	0.095	6.11
New Braunsfels	7.22	4.96	61.99	4.03	5.62	7.32	1.31	0.30	0.41	0.22	0.13	5.80
Subsoil	7.34	2.24	51.07	4.15	5.76	14.66	0.96	0.17	0.51	0.47	0.12	11.52
Waxahachie	9.06	7.77	59.90	5.44	6.81	5.17	0.67	0.14	0.15	0.35	0.04	3.98
Subsoil	7.64	5.80	53.17	5.18	6.32	10.62	1.41	0.29	0.65	0.41	0.24	8.11
Bell County black waxie.	2.42	7.34	44.23	1.58		23.98	0.94	0.15	0.12	0.22	0.25	18.00
Subsoil	1.94	2.65	48.17	2.68		23.60	1.13	0.21	0.13	0.28	0.30	18.35
Bell County hammock	3.56	6.52	77.05	2.66	4.91	1.03	0.73	0.02	0.18	1.45	1.96	0.81
Subsoil	4.91	2.51	78.09	3.98	7.74	0.83	0.90	0.02	0.17	1.07	0.33	0.65

Analyses of Texas soils and corresponding subsoils—Continued.

Locality.	Moisture.	Volatile and organic matter.	Insoluble matter and sand.	Iron oxide.	Aluminum oxide.	Calcium oxide.	Magnesium oxide.	Sulphuric acid.	Phosphoric acid.	Potash.	Soda.	Carbon dioxide.
The Panhandle soils.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Taylor County, Abilene	4.52	3.05	73.78	1.78	6.51	4.04	1.41	0.154	Trace	1.14	0.96	2.25
Subsoil	4.80	2.69	64.3	2.23	5.06	9.33	5.20	1.10	4.23	0.102	0.588	0.305
Wichita*	1.62	3.01	88.46	2.06	3.83	0.07	Trace	0.06	Trace	0.426	0.139	......
No. I red sandy	......	8.33	78.63	7.44	2.22	0.57	......	0.38	0.34	0.52	0.46	Trace
No. II sandy loam	......	7.65	74.85	4.08	3.84	3.83	Trace	0.73	0.60	0.43	0.85	2.13
The alluvial soils.												
Brazos River silt	3.26	2.69	70.92	3.62	0.558	5.66	1.85	0.29	0.34	0.885	0.224	4.00
Brazos bottom, Harlem	1.17	1.544	84.31	2.36	3.87	2.74	0.24	Trace	0.166	0.46	0.37	2.24
Subsoil	2.26	2.91	79.50	2.91	5.87	2.01	0.23	Trace	0.26	1.24	1.25	1.78
Brazos bottom, chocolate loam	3.04	3.00	78.59	2 80	6.05	1.66	0.126	Trace	0.136	1.091	0.856	2.04
Subsoil	3.28	2.50	77.57	3 18	8.28	1.82	0.18	Trace	0.128	0.841	0.443	1.71
Brazos bottom, peach ridge	4.62	9.39	76.45	2.60	3.51	0.609	0.73	0.079	Trace	0.545	0.32	0.34
Subsoil	3.11	4.70	82.97	2.33	4.73	0.424	0.338	0.134	0.154	0.482	0.262	0.28
Miscellaneous.												
College clay	5.82	3.94	76.17	2.99	8.33	0.60	0.55	0.106	0.083	0.80	Trace	0.47
Phosphate rock (?)	1.64	2.90	38.84	4.22		28.82	0.237	0.955	0.338	0.468	0.397	......

* Subsoil of same character as surface soil.

The nature and occurrence of alkali in Texas soils is briefly discussed and analyses are given of samples of alkali from Ysleta, Laredo, and the Rio Grande valley, with suggestions as to means of reclamation.

[Alkali] spots are common in the western part of the State, and are not unknown even in the eastern part; but it is the exception to find any large body of land unsuited for agricultural purposes from the presence of alkali. The alkali of Texas generally consists of common salt—sodium chloride. Sometimes there may be present sodium carbonate, and in one instance I have found calcium chloride—chloride of lime.

Analyses of soils, R. DEROODE (*West Virginia Sta. Bul. No. 28, Dec., 1892, p. 65*).—The percentages of nitrogen, phosphoric acid, potash, and lime in 13 samples of soil from different parts of the State are tabulated.

Pit experiments with prairie soil, W. L. HUTCHINSON and L. G. PATTERSON (*Mississippi Sta. Technical Bul. No. 1, Dec., 1892, pp. 4, 14, 15.*)—Brick pits 3 by 3 by 3 feet, cemented and having their bottoms of uncemented brick, were entirely filled with the surface soil (from first six inches) of the Mississippi prairies. A stalk of cotton was grown in each pit. Different fertilizers were applied. Experiments extending over two years led to no definite conclusions as to the fertilizers needed by the soils. The first year, when the loosely filled pits were in a better mechanical condition, the yield of cotton was much larger than in the second year. "Other crops do not seem to be as sensitive to the evils of a soil in poor mechanical condition, since Indian corn, clovers, a great variety of grasses, and a number of garden crops grow well on these [prairie] soils."

FERTILIZERS.

W. H. BEAL, *Editor.*

Use of fertilizers in North Louisiana, J. G. LEE (*Louisiana Stas. Bul. No. 21, 2nd ser., Feb., 1893, pp. 654, 655*).—General statements as to manurial needs of different crops on the soils of northern Louisiana.

Seaweeds, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Bul. No. 21, Jan., 1893, pp. 37, figs. 11*).—The principal purpose of this bulletin is to throw more light on "the relative and absolute value of the various seaweeds" from an agricultural standpoint. Information from a great variety of sources is summarized under the following heads: The use and value of seaweed as a manure; Methods of treating and applying seaweeds; Seaweed as a manure for potatoes; Less objection to chlorine in manures if applied the preceding season; Seaweed temporary in its effect; Seaweed not an evenly balanced manure; Seaweeds contain no objectionable weeds; Seaweeds grow rapidly; Seaweed as human food; Seaweed as a food for animals; and Miscellaneous uses of seaweeds.

Analyses by the authors and others, with illustrations and notes on distribution and habits, are given for the following species: Ribbon-weed or kelp (*Laminaria saccharina*), broad ribbon-weed or broad-leaved kelp (*L. digitata*), dulse (*Rhodymenia palmata*), round-stalked rock-weed (*Ascophyllum* [*Fucus*] *nodosum*), flat-stalked rock-weed (*Fucus vesiculosus*), *Phyllophora membranifolia*, Irish or carrageen moss (*Chondrus crispus*), *Cladostephus verticillatus*, eel-grass (*Zostera marina*), *Polyides rotundus*, and *Ahnfeldtia plicata.*

Fertilizer analyses and fertilizer control in North Carolina, H. B. BATTLE (*North Carolina Sta. Bul. No. 88, Jan. 16, 1893, pp. 23*).—Notes on valuation, a digest of the State fertilizer law, freight rates from the seaboard to the interior of the State, and tabulated analyses of 195 samples of commercial fertilizers collected during the spring and fall of 1892. This bulletin includes analyses published in Bulletins Nos. 82*a*, Feb. 13, 1892; 82*b*, Feb. 27, 1892; 83*b*, Mar. 12, 1892; 83*c*, Mar. 26, 1892; 83*e*, Apr. 16, 1892, and 86*b*, June 15, 1892.

Fertilizer analyses and fertilizer control in North Carolina, H. B. BATTLE (*North Carolina Sta. Buls. Nos. 88b and 88c, Feb. 18 and Mar. 4, 1893, pp. 8 and 10*).—Notes on valuation in 1893, a digest of the fertilizer law of the State, freight rates from the seaboard to interior points, and tabulated analyses of 92 samples of commercial fertilizers collected during 1893.

Fertilizer inspection in West Virginia, J. A. MYERS (*West Virginia Sta. Bul. No. 26, Sept., 1892, pp. 15–29*).—This includes the text of the fertilizer law with comments, a description of the method of conducting the inspection, notes on valuations for 1892, and tabulated analyses of 130 samples of commercial fertilizers.

Field experiments with fertilizers on corn, potatoes, and tobacco, M. A. SCOVELL (*Kentucky Sta. Bul. No. 45, Apr., 1893, pp. 18*).—These are continuations of experiments reported in Bulletins Nos. 28, 33, and 37, of the station (E. S. R., vol. II, pp. 225, 724; vol. III, p. 791). The experiments with corn and potatoes were on 10 tenth-acre plats, and with tobacco on 10 twentieth-acre plats of worn soil. The fertilizers used were, for corn and potatoes, muriate of potash 160 pounds, nitrate of soda 160 pounds, acid phosphate 140 or 150 pounds per acre; for tobacco, 160, 80, and 140 pounds, respectively, singly, two by two, and all three together. The financial results and meteorological data are tabulated for each test. The following summary is given:

Results obtained in 1892 are almost identical with those of the last four years, that is, wherever potash was one of the ingredients of the fertilizer used, whether on corn, tobacco or potatoes, there was an increased yield. Where phosphoric acid or nitrogen or both were used without potash, there was scarcely any increase in yield over those plots receiving no fertilizer. There was a profit in the use of fertilizer in every instance where potash was one of the ingredients. There was a loss by the use of fertilizer where potash was not one of the ingredients, except in the tobacco experiments. Potash fertilizer applied on corn has shown its effect for four seasons after the application.

Soil tests with corn, cotton, and tobacco during 1891 and 1892, F. E. EMERY (*North Carolina Sta. Bul. No. 89, Mar. 1, 1893, pp. 3–18, 35–39*).—These included three experiments with corn in different parts of the State, three with cotton, and one with tobacco in 1891; two with corn and two with cotton in 1892. The experimental fields were located "on representative soils of the chief geological areas in the State" and the results obtained "may be regarded as in a measure general for a considerable area around them." On the corn and cotton, acid phosphate, cotton-seed meal, kainit, and barnyard manure were applied singly and in various combinations; on the tobacco, muriate of potash and sulphate of potash were used in addition, to test the best form of potash for this crop. The results in each case are tabulated and summarized. For corn and cotton the results vary with the different tests. On tobacco, potash gave the best results of any single element, but the highest returns were obtained where three elements were combined.

Those plats on which potassium chloride was used have been shown to have excelled all others in total product, in net cash value, and in total cash value, save that the heaviest application of kainit balanced the lowest of potassium chloride in total cash value, and stood next to it in net result, while the lowest application of potassium sulphate resulted in giving the highest price per pound.

The results of experiments on corn to test the effectiveness of kainit as a protection against cutworms and wireworms were inconclusive, but indicate that the application was in a measure effective.

Tests of fertilizers on corn, D. O. NOURSE (*Virginia Sta. Bul. No. 23, Dec., 1892, pp. 6*).—The results of inconclusive experiments with

muriate of potash, nitrate of soda, and dissolved bone black, singly and in combination, and at different rates per acre, on 22 duplicate plats of exhausted soil are tabulated and discussed.

Experiments with commercial fertilizers on corn, D. D. JOHNSON (*West Virginia Sta. Bul. No. 28, Dec., 1892, pp. 53-67*).—Notes and tabulated data for experiments with fertilizers on corn on 10 tenth-acre plats in five counties of the State. The fertilizers used were kainit, muriate of potash, sulphate of potash, sylvinit, nitrate of soda, dried blood, dried fish, acid phosphate, floats, and stable manure. The percentages of nitrogen, phosphoric acid, potash, and lime in samples of the soils used in the experiments and of seven other soils in different parts of the State, as determined by R. De Roode, are tabulated, and the chemical composition of the soils discussed.

Summarizing the results with the different forms of potash for which the data are most complete, the following conclusions are drawn:

The average increased yield produced by 1 pound of potash contained in kainit is 31.33 pounds. The average increased yield produced by 1 pound of potash contained in sulphate of potash is 25.74 pounds. The average increased yield produced by 1 pound of potash contained in muriate of potash is 15.91 pounds. The average cost of kainit required to produce 1 bushel of corn is 9.06 cents. The average cost of sulphate of potash required to produce 1 bushel of corn is 16.32 cents. The average cost of muriate of potash required to produce 1 bushel of corn is 19.35 cents.

FIELD CROPS.

A. C. TRUE, *Editor*.

Corn experiments, J. G. LEE (*Louisiana Stas. Bul. No. 21, 2d ser., Feb., 1893, pp. 636-614*).—These are continuations of experiments reported in Bulletin No. 16 (second series) of the Louisiana Stations (E. S. R., vol. IV, p. 137). They include fertilizer experiments and tests of varieties.

Special nitrogen tests occupied 40 plats. The tabulated yields are given. The gain over no manure due to nitrogen was 12.3 bushels per acre; 24 and 48 pounds of nitrogen combined with mixed minerals gave an increase over the minerals of 10 bushels and 17.5 bushels, respectively. The corn responded generously to every form of nitrogen. The difference in yield from the different forms was very slight. Cotton seed and its products were most convenient and economical. The most profitable quantity of nitrogen was 24 pounds per acre.

Special phosphoric acid experiments occupied 24 plats. A mixture of cotton-seed meal and kainit was combined with different quantities of dissolved boneblack, superphosphate, bone meal, South Carolina floats, and Thomas slag. The results indicated that phosphoric acid in small quantities and combined with nitrogen was needed; that a large amount was unprofitable; that the soluble forms, superphosphate, and dissolved boneblack, were best.

Special potash experiments occupied 18 plats, and the results indicate that "potash is not needed in any form, quantity, or combination to grow corn on this soil."

In an experiment on the time of applying manure, made on 12 plats, nitrate of soda, ammonium sulphate, and cotton-seed meal, with mixed minerals were applied, in single applications, at time of planting, and in fractional applications. The average yield from one application was 30.3 bushels; two applications, 32.1 bushels; three applications, 35.5 bushels. In this wet season, as in previous years, fractional applications were best for corn.

Corn, test of varieties.—Tabulated results of tests of 28 varieties, embracing yield and per cent of grain, cob, and shucks. Calhoun Red Cob gave the heaviest yield, followed by Mosby.

Corn growing, C. F. CURTISS (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 605–609*).—Experiments during two years have indicated that green manuring of corn with rye or clover is not profitable on the station farm. Tankage did not increase the yield of corn or stover. Late cultivation, especially when deep, somewhat decreased the yield of corn. Topping decidedly decreased the yield of corn.

Coöperative variety tests of corn and cotton during 1891 and 1892, F. E. EMERY (*North Carolina Sta. Bul. No. 89, Mar. 1, 1893, pp. 19–33, 39–45*).—Notes and tabulated data for tests in different parts of North Carolina of 13 varieties of corn and 18 of cotton in 1891, and 6 varieties of corn and 18 of cotton in 1892. "Judging from the averages at five points in the State, the varieties [of corn] now being grown were more prolific than those bought outside of the State." The results of tests of varieties of cotton were variable in the different experiments.

Experiments with cotton, J. G. LEE (*Louisiana Stas. Bul. No. 21, 2d ser., Feb., 1893, pp. 622–636*).—These are in continuation of the experiments reported in Bulletin No. 16 (second series) of the Louisiana Stations (E. S. R., vol. IV, p. 138). They embrace (1) fertilizer tests, (2) variety tests, and (3) experiments to determine the best distances for cotton stalks.

Cotton, fertilizer tests.—Nitrate of soda, sulphate of ammonia, cottonseed meal, cotton seed (raw and composted), dried blood, and fish scrap were each used in such quantities as to supply 24 pounds of nitrogen per acre (single ration) and 48 pounds (double ration). The variety planted was Eureka (long staple) cotton.

The yields of cotton at three different pickings are tabulated. The land was uneven, but the results showed that nitrogen was needed. The average yield where no manure was used was 340 pounds of seed cotton per acre. Nitrogen alone produced a gain of 287 pounds per acre, and mixed minerals 58 pounds; when 24 pounds of nitrogen was added to the minerals the gain was 302 pounds, and when 48 pounds of nitrogen was added 395 pounds.

The average per cent of increase due to nitrate of soda was 83, to sul-

phate of ammonia 49, to dried blood 49, to fish scrap 107, to cotton-seed meal 89, to crushed cotton seed 87, and to rotton cotton seed 71.

The average increase from the two mineral forms of nitrogen, sodium nitrate and ammonium sulphate, was 66 per cent; from the two animal forms, dried blood and fish scrap, 78 per cent; and from the three vegetable forms, cotton-seed meal, crushed cotton seed, and rotten cotton seed, 82 per cent. The mineral forms, which are most soluble, gave poorest results this very wet year, though previously they had given somewhat better results than the organic forms. The vegetable forms proved most convenient and economical. "Concurrent results of four years strongly indicate that on these soils one ration, or 24 pounds, of nitrogen per acre is more profitable than larger quantities."

Special phosphoric acid experiments occupied 25 plats. Different amounts of dissolved boneblack, superphosphate, bone meal, South Carolina floats, and Thomas slag were used alone and combined. Phosphates did not give such large increase in the yield as in the three years previous. The average increase of uncombined phosphates over no manure was 102 pounds, but when added to a combination of cotton seed meal and kainit there was no increase over the latter. The soluble forms, dissolved boneblack and acid phosphate, proved most effective. In every instance the double ration of phosphoric acid involved financial loss.

In the special potash experiments, which occupied 21 plats, different amounts of potash in the forms of kainit, cotton-hull ashes, and muriate and sulphate of potash were applied. The variety planted was Kennith (long staple) cotton. Potassic fertilizers caused a slight loss when applied alone or in combination.

Two experiments, each on 4 plats, made to compare yields of cotton with fertilizers (superphosphate, muriate of potash, and cotton-seed meal) as a top-dressing and applied at depths of from 3 to 8 inches, gave results in favor of shallow applications.

The tabulated results are given of an experiment on 12 plats, in which nitrate of soda, sulphate of ammonia, and cotton-seed meal, used in connection with mixed minerals, were applied all at time of planting, and in fractional applications during the growing season. The results, as in previous years, were in favor of the application at time of planting.

Cotton, varieties.—Tabulated data for 34 varieties are given. The soil of the plats on which the varieties were grown was uneven, and the table shows great differences in yield. The low per cent of lint found was ascribed to dullness of the gin saws.

A chemical study of the cotton plant, W. L. HUTCHINSON and L. G. PATTERSON (*Mississippi Sta. Technical Bul. No. 1, Dec., 1892, pp. 3–14*).—The cotton crops of 1890 and 1891, grown on a different field each year, were studied. Analyses of two soils are given, also proximate and ash analyses of the young plants. Later the roots, stems,

leaves, and bolls were analyzed at intervals of ten days, until most of the bolls had matured and some of them had opened. As the plants matured, crude fiber increased in the roots, stems, and bolls; the nitrogen and ash ingredients decreased in the roots and stems.

The author concludes that deficient fruiting and shedding of forms are not due to either the quantity or quality of fertilizing constituents.

Comparisons are made with results published in Bulletin vol. IV, No. 5 of the Tennessee Station (E. S. R., vol. III, pp. 540–573).

Varieties of cotton, E. R. LLOYD (*Mississippi Sta. Bul. No. 23, Feb., 1893, pp. 3*).—This consists of a tabular statement concerning 26 varieties of cotton, and embracing data on the following points: Date of heaviest picking; weight of seed and lint per acre; per cent of lint; price per pound of lint; and value of lint, seed, and total crop per acre. The five varieties giving the highest values per acre were Warren \$35.72, Jones Long Staple Prolific \$32.53, Drake's Cluster \$32.43, King \$30.63, and Smith Standard \$29.51. The highest price per pound, 13 cents, was obtained for the W. A. Cook cotton.

Fertilizers for cotton, W. L. HUTCHINSON (*Mississippi Sta. Bul. No. 24, Feb., 1893, pp. 4*).—This bulletin consists of a brief statement of the manurial needs of the cotton plant on different soils. The conclusions are based on experiments in Mississippi and elsewhere. For sandy and sandy loam soils the author recommends from 200 to 600 pounds of a fertilizer containing 2½ per cent of nitrogen, 8 per cent of water-soluble phosphoric acid, and 2 per cent of potash. Red, sandy lands with clay subsoil respond to a fertilizer containing 3 per cent of nitrogen and 8 to 10 per cent of water-soluble phosphoric acid. Potash is not required. Black and gray prairie soils do not respond to commercial fertilizers, but need tile drainage and leguminous crops. Yellow loam lands demand a fertilizer rich in potash with a small percentage of nitrogen and phosphoric acid. The brown loam soils of the bluff formation respond well to fertilizers, and require the same plant food as the sandy loam soils. There are also brief directions for the care of stable manure, making compost, and applying fertilizers.

Depth of covering grass seed, J. WILSON and C. F. CURTISS (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 610–612*).—An experiment on sandy loam soil, in which grass seed was planted at depths of from one half to 3 inches, gave the following indications:

The indications for such a season as that of 1892 are that clover, covered 2 and 3 inches deep, stands a severe fall drouth better than that covered less, while lighter coverings give better yields at first cutting.

Timothy covered 1 inch deep gave most hay at first cutting; but that sowed 2 inches deep stood drouth best.

Tall meadow oat grass, covered 2 inches deep, gave the most hay at first cutting and showed the best fall conditions.

Bromus inermis, covered 1 inch deep, gave most hay at first cutting, and that covered 2 inches deep showed the best fall condition.

Experiments with oats, corn, spring wheat, and potatoes, A. C. MAGRUDER (*Oklahoma Sta. Bul. No. 4, Oct., 1892, pp. 8, plate 1*).—A brief account of the first year's test of ten varieties of oats and three varieties of spring wheat. The oats were greatly damaged by smut and the wheat by chinch bugs. Most of the varieties of corn tested did not mature, owing to late planting. In a small experiment with potatoes, whole tubers yielded 163 bushels per acre, halves 92, and eyes 155.

Northern *vs.* **Southern seed potatoes,** E. H. BRINKLEY (*Maryland Sta. Bul. No. 17, June, 1892, pp. 256, 257*).—A brief account of a test of Queen potatoes from seed grown in Maine and Maryland. This work was in continuation of that recorded in the Annual Report of the station for 1891, p. 374 (E. S. R., vol. IV, p. 38). The Maryland seed yielded 95 and the Maine seed 72 bushels per acre.

Experiments with sorghum, G. H. FAILYER and J. T. WILLARD (*Kansas Sta. Bul. No. 36, Dec., 1892, pp. 121–137*).—This is a continuation of work reported in Bulletin No. 25 of the station (E. S. R., vol. III, p. 696), and includes tests of varieties, improvement by seed selection, and trials with fertilizers. Analyses of the juice are tabulated for general samples and for single stalks.

April and May, 1892, were extremely wet. A drouth extending from the early part of June until after the middle of July checked the growth of the plants. Occasional rains after this time did not cause a full recovery. The close of the season was favorable. The plants were inferior in size and the percentage of juice was less than usual.

Large samples of variety "208" analyzed 19.36 per cent of cane sugar and 0.76 per cent of glucose sugar; Undendebule, 18.71 per cent, and 0.87 per cent; Kansas Orange, 17.26 per cent, and 1.12 per cent; cross of Amber and Orange (Coleman), 17.33 per cent, and 1.21 per cent; cross of Amber and Orange (not the same as preceding), 17.17 per cent, and 1.04 per cent; "8x," 16.98 per cent, and 0.68 per cent; Nearly Seedless, 16.18 per cent, and 0.66 per cent; McLean, 16.34 per cent, and 1.21 per cent; Early Amber, 15.48 per cent, and 1.45 per cent.

Improvement by seed selection.—The work of improving sorghum by selecting seed from individual stalks of special merit has been in progress for five years.

The following table shows the improvement effected, which, after allowing somewhat for acclimatization and perhaps for favorable seasons in 1891 and 1892, remains largely to the credit of persistent scientific seed selection.

Cane sugar in sorghum juice during five years.

	Kansas Orange.		Early Amber.		Link Hybrid.		Cross of Orange and Amber.		Undendebule.	
	Average.	Best single stalk.	Average.	Best single stalk.	Average.	Best single stalk.	Average.	Best single stalk.	Average.	Best single stalk.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
1888	12.62	15.51	....	....	14.01	14.27	12.70	14.18	....	....
1889	13.88	16.79	13.95	15.56	15.32	16.94	14.83	17.47	....	....
1890	11.65	Frozen	14.37	16.01	10.95	14.47	14.59	16.03	13.47	15.79
1891	16.82	18.59	12.75	16.48	16.37	17.41	16.49	18.25	17.21	18.95
1892	17.30	19.26	15.62	17.23	16.40	17.88	16.72	18.95	18.27	20.39

Fertilizer tests.—Fertilizers were applied on different plats as follows: Two hundred pounds of nitrate of soda, 200 pounds of sulphate of potash, 300 pounds of superphosphate, and 100 pounds of plaster; 20 bushels of lime per acre; 600 pounds of superphosphate; 400 pounds of nitrate of soda; 400 pounds of sulphate of potash; 200 pounds of plaster; 150 pounds of salt. Alternate plats received no manure. The analyses of the juice and average weight of the dressed canes are tabulated; also the difference between the juice from fertilized and unfertilized plats for three years. In all three years nitrate of soda gave a slight increase in sucrose over no manure, the average difference being 0.47 per cent. All other fertilizers showed an average loss, though a gain in some years. The experiment will be continued.

Experiments with sorghum and sugar cane, J. G. LEE (*Louisiana Stas. Bul. No. 21, 2d ser., Feb., 1893, pp. 650–654*).—These embrace a test of 6 varieties of sorghum with analyses of juice and an experiment in sugar-making; and analyses of raw, limed, and sulphured juice, of masse cuite, and of centrifugal sugar. Coleman sorghum was ground and worked up into sugar on a small open pan, and yielded 74.2 pounds of dry sugar per ton, polarizing 90.3. Cane worked up in the same way as sorghum gave 122 pounds of sugar and 5.98 gallons of molasses per ton. Analyses of cane fertilized with different substances, of the juice which exudes from the butt of cane in grinding, and of different varieties of sugar cane are given.

Experiments with sugar beets, G. H. FAILYER and J. T. WILLARD (*Kansas Sta. Bul. No. 36, Dec., 1892, pp. 138–150*).—In 1892 beet seeds were sent to 251 farmers in Kansas. Only 85 sent in beets for analysis. Analyses of the juice of all the samples received are given. There is a tabular statement embracing the names and locations of growers, kind of soil, depth of preparation, date of planting, distance between plants, character of cultivation, and variety, form, and weight of beets. The season was unfavorable and the results "can not be regarded as lending great encouragement to the hope of successful establishment of the beet sugar industry in this State. There are, however, a considerable number of samples showing a high percentage of sugar."

Beets grown on the station farm were faulty in form and gave a low percentage of sugar.

The article also contains instructions for growing sugar beets and for taking samples.

Sugar beets, H. SNYDER (*Minnesota Sta. Bul. No. 27, Feb., 1893, pp. 63–72*).—Analyses are reported of samples of a large number of varieties of beets grown at the station and collected at different dates between September 24 and October 26, together with analyses of beets grown on farms in twenty-one different counties in the State. The average of 73 samples grown at the station showed 14.9 per cent of sugar in the juice and a purity of 86.3. The beets grown in different counties of the State ranged from 12.5 per cent of sugar in the juice with a purity of 78.3 to 17.8 per cent of sugar and a purity of 90.8. "The purity of the juice and high per cent of sugar of the beets grown on the sandy loams of Anoka County under direction of an expert is significant, as is the small size of the beets sent for analysis."

Sugar beets in Oregon, G. W. SHAW (*Oregon Sta. Bul. No. 23, Feb., 1893, pp. 22, map 1, charts 4*).—An account of experiments in 1892 in continuation of those reported in Bulletin No. 17 of the station (E. S. R., vol. III, p. 806). Tabulated analyses are given of 160 samples grown in different parts of the State during two years. The average of 65 analyses in 1892 was 15.7 per cent of sugar in the juice.

Tobacco growing in Louisiana, W. C. STUBBS (*Louisiana Stas. Bul. No. 20, 2d ser., Jan., 1893, pp. 566–588, figs. 6*).—This consists of an address read before the State Agricultural Society. It embraces notes on the history, statistics, and classification of tobacco. The geological formations of Louisiana are reviewed and the conclusion is reached that a large proportion of the soils of the State is suited to tobacco culture. A description of the growth and method of curing of Perique is given, with directions for preparing seed beds, transplanting, cultivating, topping, suckering, priming, worming, cutting, curing, assorting, and packing tobacco. There are also specifications for building modern tobacco barns with illustrations, and directions for curing by the leaf system.

Tobacco experiments at the North Louisiana Experiment Station, J. G. LEE (*Louisiana Stas. Bul. No. 20, 2d ser., Jan., 1893, pp. 589–606*).—The methods of cultivating and caring for tobacco are given, together with accounts of variety and fertilizer tests.

Tobacco, varieties.—Ten varieties of tobacco were tested. The yellow varieties succeeded best, Hester and Ragland Improved leading, with Conqueror, Long Leaf Gooch, and Sweet Oronoco closely following. The cigar varieties produced lighter yields and a poorer quality.

Tobacco, fertilizer tests.—Duplicate experiments with different soils showed that potash was not greatly needed, while every form of nitrogenous manure produced an increase of yield. The average of all fertilized plats was 1,280 pounds per acre; the average of all unfertilized plats, 712 pounds per acre. The expert who cured the tobacco was most pleased with the quality of that which had been fertilized with a

mixture of cotton-seed meal, acid phosphate, and sulphate of potash. In three experiments to test the quantity of a complete fertilizer that should be applied, 240 pounds, 360 pounds, and 450 pounds per acre were compared. In two cases 360 pounds gave the most profitable result, and in one case 480 pounds.

Winter wheat, J. WILSON and C. F. CURTISS (*Iowa Sta. Bul. No. 19, Nov., 1892, p. 613*).—Of 12 varieties seeded September 24 and 25, 1891, Turkish Red alone escaped the attack of rust. It lodged badly, but yielded 24 bushels per acre of good grain.

Soiling crops, J. WILSON, C. F. CURTISS, and W. H. HEILMAN (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 622–626*).—"One of the objects of this experiment was to ascertain for Iowa farmers how they could economically grow crops with sufficient nitrogen to balance the corn crop of the State. The flax, wheat, oats, rye, and barley crops that are resorted to for this purpose are depleting crops, while the legumes are recuperating crops."

Oats and peas (pp. 623–625).—Eight varieties of peas were sown with oats at the rate of $1\frac{1}{2}$ bushels of oats and $1\frac{3}{4}$ bushels of peas per acre. The peas were sown broadcast with an ordinary grain seeder and cultivated both ways. Then the oats were sown and harrowed in. The crops were cut from July 7 to 29. The yield of green and dried crop cut July 23 is given for 6 varieties as follows:

Yields of peas grown for soiling.

	Tons, dry.[1]	Tons, green.
Scotch green peas	2.8	9.6
Greenfield	2.8	10.2
Rennie No. 10	3.28	10.9
White Marrowfat	3.4	9.6
Golden Vine	2.8	8.8
Black-Eyed Marrowfat	3.2	8.4

* The dry weight reported in yields per acre is from the sun-dried sample by process of ordinary curing.

The following table gives the analyses of a mixture of the 8 varieties of peas and oats cut July 7 and July 29:

Composition of oat and pea fodder.

	Green material.		Water-free material.*	
	Cut July 7.	Cut July 29.	Cut July 7.	Cut July 29.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	83.07	67.78		
Crude ash	1.56	2.12	9.19	6.61
Crude fat	0.64	1.14	3.78	3.53
Crude protein	3.21	4.51	18.94	13.99
Crude fiber	5.01	9.63	29.62	29.87
Nitrogen-free extract	6.51	14.82	38.47	46.00

[1] Calculated.

"The foregoing table shows that a composite sample of the 8 varieties taken July 29 contained a higher proportion of carbohydrates, and correspondingly less of protein and fat. The nutritive ratio is 1 to 3.9. The last sample was too ripe for hay making."

Analyses are also given of 4 varieties of the peas alone.

Rape (pp. 625, 626).—English field rape was sown in drills at several dates, beginning May 27. Some rows were left unthinned and others were thinned out to from 1 to 8 inches in the rows, four rows in each case receiving the same treatment. The yield ranged from 12.8 to 16.8 tons per acre.

The heaviest yield came from thinning to 8 inches in the row, but the stems were heavier, and when fed to sheep and other stock there was more waste in the rape grown this way than that grown with finer stems. The indications from this trial are that it does not pay to thin. * * * The crop was attacked by grasshoppers, cabbage worms, and lice, and this occurred to all plantings on all soils. The plants were injured to the extent of half of their foliage. All kinds of stock relished it. Calves would leave their grain for it, but when it became lousy stock refused it.

The results of growing and feeding rape were very satisfactory, and were it not for the insect enemies there is no doubt but that the crop would soon take an important place in farm management for soiling and late fall feeding.

Field experiments with sundry crops, J. G. LEE (*Louisiana Stas. Bul. No. 21, 2d ser., Feb., 1893, pp. 645–647*).—Tabulated yields of pearl millet, Jerusalem corn, yellow millo maize, white millo maize, large African millet, Kaffir corn, German millet, soja bean, and 7 varieties of sorghum. African millet yielded the greatest weight of cured fodder. The yields of seed from Jerusalem corn, yellow millo maize, white millo maize, African millet, and Kaffir corn are given, ranging from 8 bushels for Jerusalem corn to 37.8 bushels for African millet. Brief notes are also given on Spanish peanuts, sunflower, castor bean, jute, lintless cotton, and 14 varieties of field peas.

Rotation of crops, J. G. LEE (*Louisiana Stas. Bul. No. 21, 2d ser., Feb., 1893, pp. 620–622*).—Tabulated results are given of the yields of crops on two series of plats. The same rotation has been in use on both series for four years. One series received no fertilizer; the other was regularly fertilized. The rotation consists of corn, oats followed in the same season by cowpeas, and cotton. It is preferred that corn should precede cotton, but cotton can not be removed in time to sow rust-proof oats in the fall, while corn can be harvested in time for this. The short time during which this experiment has been running does not admit of conclusions regarding the renovating influence of such a rotation. "The earlier maturity of the fertilized crops, especially cotton, is distinctly marked every year."

Root crops, J. WILSON and C. F. CURTISS (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 601–604*).—A brief account of an experiment in the culture of mangel-wurzels, ruta-bagas, carrots, and sugar beets.

HORTICULTURE.

A. C. TRUE, *Editor.*

On the crossing of cucurbits, L. H. PAMMEL (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 595-600*).—Experiments by the author are reported which confirm results obtained elsewhere, in indicating that the different species of cucurbits will not produce hybrids under any ordinary conditions.

To insure, if possible, a perfect intermingling of the varieties of melons, cucumbers, pumpkins, and squashes, they were planted as follows: Watermelons, various varieties, in one row; second row, muskmelons and sugar melons and Sweet Sugar pumpkins, followed by a row of American Turban and Bush Scalloped, Italian Striped, and Improved Long Green cucumbers. Then a row of several varieties of cucumbers, Perfect Gem squash, and New Mediterranean. The fifth row was planted with common pumpkins, watermelons, and citrons. The sixth row with muskmelons, Dipper Gourd, and Hubbard squashes. The seventh, Marrow squashes, New Prolific Marrow, and Vegetable Marrow and Dipper Gourd. The eighth with common pumpkins. * * *

In all of the varieties grown in the field where pollination was brought about by insects no immediate effects were observed. Some of the varieties showed great variability, especially *Cucurbita pepo* and *C. maxima*. This variability was due to the character of the seed planted. In some cases the varieties are not sufficiently stable, or perhaps they showed the effects of a previous cross. These variations were noticeable especially in the Nest Egg Gourd, Perfect Gem, Long Warted, and Vegetable Marrow. The Hubbard Improved Vegetable Marrow, American Turban squashes, and the Sweet Sugar and common pumpkins came true to the type. In all of these the deviations were traced to plants coming from distinct seeds, and in no case was any immediate effect of crossing observed.

About 400 careful hand pollinations were made. * * * Out of this number quite a number set and produced perfect fruit. These fruits fully bear out the general statement that there is no immediate effect on the fruit either in shape, size, or quality, nor is there any difference in the seed. * * *

I found that several varieties [of muskmelons], like the Montreal Improved and Miller Orange Cream, produce perfect flowers. At Ames quite a number were covered to see if self-fertilization would occur, but in no case was there any development.

Variety tests of sweet potatoes, J. G. LEE (*Louisiana Stas. Bul. No. 21, 2d ser., Feb., 1893, pp. 647-649*).—Descriptive notes and tabular statement of yield of 14 varieties of sweet potatoes. Peabody gave the highest yield, 379 bushels per acre; it was followed by Barbadoes, Hayman, Southern Queen, and Shanghai, in order named.

Sweet potatoes, E. H. BRINKLEY (*Maryland Sta. Bul. No. 18, Oct. 1892, pp. 8*).—Tables from the Tenth U. S. Census are quoted showing the acreage, total yield, and yield per acre of sweet potatoes in the several States, and also in the different counties of Maryland. Tabulated results of a fertilizer test are given. Phosphatic fertilizers gave good results, though the figures indicate that the soil was not uniform. There are also notes on the cultivation of the sweet potato.

Sweet potatoes, J. C. NEAL (*Oklahoma Sta. Bul. No. 4, Oct., 1892, pp. 7, 8*).—A brief account of a first year's test of 15 varieties.

Experiments with new orchard fruits, trees, and shrubs, J. L. BUDD (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 535–565*).—"In the spring of 1883 a bulletin was issued [by the Iowa Agricultural College] giving an outline of the author's experiments with and investigations of some of the fruits and ligneous plants of the steppe sections of east Europe and north central Asia. Since that time we have made several importations of scions and rooted plants from the parts of east Europe where the summer heat is nearly or quite equal to ours, and we have sent out many thousands of plants for trial across the continent on our northern borders. The present notes are a summary of the reports received from our trial stations and of our observations on the college grounds up to date, of a part of the varieties and species which we now have in the nursery for distribution in the spring of 1893."

Brief descriptive notes are given on the following varieties, which tests have shown to be valuable:

Apples—Summer varieties—Yellow Transparent, Blushed Calville, Breskovka, Plodovitka, Voronesh Arkad, Anisette, Revel Pear, Borovinka, Lubsk Queen, and Early Sweet; autumn varieties—Revel Borsdorf, Longfield, Rosy Repka, Repka Aport, Green Crimean, Hibernal, Keiv Reinette, Gipsy Girl, Mallett, Large Anis, Antonovka, Aport Orient, Golden Reinette, Posarts Nalivia, Kursk Reinette, Sandy Glass, Rambour Queen, Silken Leaf, Pointed Pipka, Bergamot, and Harry Kaump; winter varieties—Aport Voronesh, Arabskoe, Bogdanoff, Bogdanoff White, Sklanka Bogdanoff, Volga Cross, Cross, Marmalade, Ostrakoff, Ledenets, Lead, Royal Table, Aport, Borsdorf, Repka Malenka, Regel, Zuzoff Winter, Romna, Voronesh Rosy, Grandmother, Swinsovka, Red Queen, Boiken, Citron, Battulen, Winsted Pippin, and Burlington.

Crab apples.—Longfield, Marble, and Recumbent.

Pears.—Bessemianka, Limber Twig, Gakovsky, Autumn Bergamot, Kurskaya, Victorina, Early Bergamot, Flat Bergamot, Winter Pear, Dula, Saccharine, Lemon, Mongolian Snow Pear, and Golden Russet.

Cherries.—Early Morello, June Morello, Griotte Precoce, Boquet Morello, King Morello, Griotte du Nord, Sklanka, Orel Sweet, Strauss Weichsel, Bessarabian, Frauendorfer Weichsel, Cerise d'Ostheim, George Glass, Double Natte, Lithauer Weichsel, Lutovka, 24 Orel, Vladimir, Brusseler Braun, 27 Orel, Orel, Shubianca, Shadow Morello, Späte Morello, and Large Long Late; varieties for south Iowa—Heart-Shaped Weichsel, Red Oranien, Bunte Morello, Yellow Glass, and Vilne Sweet.

Plums.—Native varieties—De Soto, Wolf, Wyant, Rollingstone, Cheney, Hawkeye, Chippewa, Pottawattamie, Forest Rose, and Maquoketa. East European varieties—Early Red, Moldavka, Voronesh Yellow, Leipzig, Dame Aubert, Hungarian Prune, Ungarish Prune, Hun-

garian No. 1, Black Prune No. 1, Beer Plum, Wyzerka, Long Red, Long Blue, Minnesota, Communia, Richland, Prunus Simoni, and Shense Apricot.

Trees for shelter belts and timber.—White poplar, silver-white poplar, Asiatic poplar, Petrovsk poplar, red willow, golden willow, and pointed-leaved willow.

Ornamental trees.—Bolle's poplar, laurel-leaved willow, Napoleon willow, silver-leaved willow, rosemary-leaved willow, wild olive, *Prunus maacki*, bird cherry, *Acer ginnala*, and *Alnus incana.*

Ornamental shrubs.—Amur tamarix, *Viburnum lantana*, Russian snowball, mock orange, Amur barberry, Chinese barberry, privet, *Lonicera splendens*, *L. xylosteum*, *L. alberti*, climbing honeysuckles, *Rosa rugosa*, and spiræas.

The station orchard and vineyard, J. G. LEE (*Louisiana Stas. Bul. No. 21, 2d ser., Feb., 1893, pp. 610–617*).—A list is given of varieties of peaches, apples, pears, persimmons, and grapes recently added to the station orchard and vineyard, and notes on 26 varieties of peaches, of which the following are recommended for northern Louisiana: General Jackson, Oriole, General Lee, Early Rivers, Alexander, Newington, Old Mixon Cling, Sylphide Cling, Picquett Late, Early Crawford, Stump the World, and Pineapple. There are also notes on 9 varieties of plums, 6 of nectarines, 3 of Japanese persimmons, 6 of figs, 6 of apples, the black apricot, the Angers quince, and the Dr. Jules Guyot pear.

Strawberries, J. S. ROBINSON (*Maryland Sta. Bul. No. 13, June, 1891, pp. 10*).—Tabulated data for 30 varieties tested at the station. The 10 most productive varieties were Staymen No. 1, Sadie, Warfield No. 2, Mrs. Cleveland, Cling-to, Staymen No. 2, Thompson No. 7, Van Deman, Crescent, and Cloud.

Strawberries, J. S. ROBINSON (*Maryland Sta. Bul. No. 17, June, 1892, pp. 252–255*).—Brief descriptive notes on 23 varieties tested by R. L. Gulick at East New Market, Maryland. The best varieties were Acme, Michel Early, Hoffman, Bubach No. 5, Daisy, May King, Alabama, Parker Earle, and Gandy.

Bush fruits, W. B. ALWOOD (*Virginia Sta. Bul. No. 22, Nov., 1892, pp. 103–110*).—A summary of the results of tests made at the station since 1889. The following varieties are recommended: *Gooseberries.*—Downing, Houghton, and Pale Red. *Currants.*—Cherry, Red Dutch, and Lee (black). *Raspberries.*—Brandywine, Cuthbert, and Turner—red varieties; Doolittle and Hilborn—black; Caroline—yellow; Muskingum and Shaffer—purple. *Blackberries.*—Wilson, Ancient Briton, and Taylor. *Juneberries.*—Success.

Notes on pruning, C. BECKER (*West Virginia Sta. Bul. No. 27, Nov., 1892, pp. 33–49, plates 3, figs. 17*).—Illustrated directions for pruning orchard and small fruits, grapes, and shade trees.

Coöperative horticultural work, W. F. MASSEY (*North Carolina Sta. Bul. No. 89, March 1, 1893, pp. 46*).—A brief report on experiments with fertilizers on vegetables, and tests of fruits at Newbern, North Carolina, and on fertilizer experiments on grapes at Southern Pines, North Carolina.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Preventive treatment of some fungous diseases, E. S. GOFF (*Wisconsin Sta. Bul. No. 34, Jan., 1893, pp. 13, figs. 5*).—Popular descriptions are given and preventive treatment is recommended for apple scab, downy mildew and brown rot of the grape, potato blight, and smut of wheat and oats. For the apple and potato diseases Bordeaux mixture is recommended, for the grape diseases Bordeaux mixture until the berries begin to color, after which ammoniacal carbonate of copper is advised; while for the smut of wheat and oats the hot-water treatment is favored. The fungicides are prepared according to standard formulas. A spraying apparatus is described and figured, showing a new device to keep the solution well stirred.

ENTOMOLOGY.

Experiments with the tar pan for leaf hoppers on pasture land, H. OSBORN (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 566–571*).—An account of observations and experiments in continuation of those reported in Bulletins Nos. 13 and 14 of the station (E. S. R., vol. III, pp. 218 and 222). Two pieces of blue-grass pasture land, each containing about $1\frac{3}{4}$ acres, were selected to test the advantages of using the hopper-dozer for the repression of leaf hoppers. One lot was left untreated. Over the other lot the hopper-dozer, consisting of a heavy pan of sheet-iron, 8 by 3 feet, coated with coal tar, was dragged June 4, 8, 9, 24, and 25, and July 7 and 20. The untreated lot furnished pasturage for one Shorthorn cow, weighing 1,200 pounds, during 103 days, and the treated lot for two cows 86 days, equivalent to 172 days for one cow. This result confirmed that of previous experiments in indicating that pasturage may be increased one-third to one-half by the use of the hopper-dozer.

The life history of the two most injurious species now being known, it seems that the dozer may be used most effectively at three different dates throughout the year, viz, when the first brood of both species occurs as larvæ, from May 25 to June 10; again from July 15 to 25, when second brood of *debilis* is to be taken; and again about August 10, when second brood of *inimicus* is to be taken. If more applications are desired they should be adjusted so as to catch the third brood of larvæ as they appear. Evidently thorough and successful work upon the first brood should reduce the necessity for later operations.

The experience of the present year shows that the tar pan will give the best results if used in the afternoon of a warm day (perhaps best from 3 to 6 p. m.), and when there is little or no breeze. This is necessary when grass is in bloom.

With regard to the cost incurred, it may be said that the cost of sheet iron, which will last for a long time, is only $1 or $1.50. The tar used is scarcely to be counted an expense, and the cost may be considered as limited to the labor involved. In operation two men have usually covered the plat mentioned, 1¾ acres, in about two hours, lapping strips so that the ground is covered twice. One man working alone can cover the same ground in but little longer time, but needs a somewhat lighter sheet for rapid work.

At the first rate it cost, counting a man's services at $1 a day, about 20 cents per acre for treatment.

On a larger scale and placing three or four such sheets in line, or using a continuous sheet, so as to cover a strip 30 or 40 feet wide at once, four men could easily cover 6 acres per hour, at a cost of about 7 cents per acre. Horse power could doubtless be used at still less expense, provided the ground was smooth enough to permit the sheet to run without catching.

Clover seed caterpillar, H. A. GOSSARD, (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 571–589, fig. 1*).—An account of observations in 1892 on *Grapholitha interstinctana* in continuation of those reported in Bulletins Nos. 14 and 15 of the station (E. S. R., vol. III, pp. 222 and 784), together with a summary of previous work on this insect at the station and elsewhere. The following are some of the observations reported in 1892:

[In 1892 the spring brood] was extremely late in this section, and the first moth was taken on May 23, another May 25, and three on June 2. It was not until the middle of June that the brood reached its maximum, though it disappeared but little later than the corresponding brood disappeared last year, the bulk of each going during the last week of June. One adult was observed June 30, or six days later than the last adult of the same brood was seen last year. * * *

Observations during the season of 1892, upon this brood, are as follows: June 28, eighty-seven heads of clover were selected at random, from the same field upon which observations were made last year, the clover having been cut for hay the day before, June 27. Seventy-four heads were, and apparently had been, free from the caterpillar, two heads had been doubtfully infested, and eleven heads were infested at the time of examination. This would show that about 15 per cent of the heads were infested this season at the time of cutting. We believe that this was a lower percentage than the field actually averaged, and it certainly does not represent the percentage of damage that the insect inflicted upon this cutting as will be readily seen in the subsequent discussion of the habits of the third or hibernating brood of caterpillars. An examination of stored hay, made this year, confirmed last year's observation as to the fate of the caterpillars. Clover near the outside of the mass may develop worms that are nearly mature at the time of storing, and we found an empty cocoon in such a situation, suggesting, but not proving, that the moth had emerged, since the caterpillar sometimes spins a cocoon for some time before pupating, and if disturbed during the interval, will take up its abode elsewhere, leaving its cocoon empty, as was this one. Heads of clover taken from the interior of the pile showed the dead and shriveled caterpillars as in former observations. * * *

Examination, July 1, of some heads of clover left uncut along the borders of the field, revealed that the few moths living at the date of cutting, and perhaps adjacent to the edge of the field, had congregated on them for the purpose of ovipositing, as many as seven larvæ being found in a single head, and ranging in size from the newly hatched caterpillar to the well matured specimen. Hardly a head could be found in this situation that was not infested with from three to five worms. We think that possibly this habit may be turned to economic account, by leaving narrow swaths of bloom uncut at regular intervals through the field, where part of

the eggs for the first brood of caterpillars, and most of the eggs for the second brood, will probably be deposited, and the larvæ can be destroyed with comparative ease as soon as the second brood of moths disappears.

We believe that if this is done the attack upon the mown portion of the field will be in some measure lessened. * * *

In 1892 the adults of the second brood were found in the field July 21, and began appearing in our breeding jars July 22. They had probably appeared some days before they were observed, and we have no record of when they disappeared. * * *

In 1892 a few fresh moths were seen August 24, which proved to be the pioneers of the third brood.

In 1891 we thought we found some indications of a tendency of the moth to become four-brooded. We had a record of some adults, observed October 9, which led to this inference. The observations made upon the third brood of 1891, however, were somewhat disconnected, and we now believe that if it had been continuously watched we would have found the last adults observed to be stragglers of the third brood. * * *

The present season, 1892, has furnished continuous observation upon the brood, which had not wholly disappeared by September 25. * * *

Observations made during the warmer days of February, 1892, showed great numbers of the worms to be apparently dead. No signs of their remains could be discovered in the spring, but the number of caterpillars to be found at this time were certainly reduced 75 per cent from the numbers observed in the fall. * * *

April 22 the larvæ were found secreted beneath rubbish, particularly in barnyard manure, which had been heavily spread over some parts of the field. Most of the worms were full fed at this date and pupated in their sheltered retreats without returning to the clover plants to feed. Some were still immature and feeding in the crowns of the plants which, it seems, they had never left. The most careful and diligent searching at this date failed to find the caterpillars in any position of the field except where it was heavily manured, and this was too remote from the parts that seemed uninfested to admit of supposing that the caterpillars had migrated to it for protection. * * *

The most abundant parasite at Ames is *Microdus laticinctus*, Cress. * * *

Another ichneumonid that is associated with *Grapholitha* in marked numbers and corresponds with it very closely in time of appearing is *Bracon vernoniæ*, Ashm., which has been reared from *Platynota sentana* and *Eudemis botrana* in the seed capsules of *Vernonia noveboracensis* (Insect Life, vol. II, p. 349). * * *

Platynota sentana and *Eudemis botrana* are not in our collections, and while it is possible that they occur here the presumption is quite strong in our mind that *Bracon vernoniæ* also preys upon *Grapholitha interstinctana*, although it has not yet been reared from this host.

Potato stalk weevil, F. A. SIRRINE (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 589–594, fig. 1*).—An account of observations on *Trichobaris trinotata*, which was very injurious to potato vines in Iowa in 1892. Previous work on this insect is reported in Bulletins Nos. 11 and 12 of the station (E. S. R., vol. II, pp. 332 and 719). No means of repression are suggested, except the familiar one of pulling the vines as soon as they wilt and burning them.

Biology of the cattle tick, C. CURTICE (*Texas Sta. Bul. No. 24, Dec., 1892, pp. 237–252, plates 2*).—A life history of the common cattle tick (*Boophilus bovis*, Riley). There are four stages: (1) an egg, (2) a six-legged seed tick, (3) an eight-legged asexual nymph, and (4) an eight-legged adult. The adult female drops from the host and lays

her eggs in the soil or litter of barn or pasture, from which the young ticks find their way to cattle.

The cattle tick, preventive measures for farm and range use, M. FRANCIS (*Texas Sta. Bul. No. 24, Dec., 1892, pp. 253–256, fig. 1*).—Cattle ticks are most abundant during hot dry seasons. They are found in Texas during the entire year. They "prefer the Durham to any other breed of cattle," and are most abundant on cattle in thickly wooded pastures or where there is much underbrush and decaying vegetable matter. "In pastures that have been [recently] under cultivation and where rotation of crops is practiced ticks are practically unknown. It is well to keep sulphur and salt in reach of the cattle. External applications of lard and sulphur and of lard and kerosene gave good results, but several brands of sheep dip were more satisfactory.

A few dairy cows are easily treated with mops, brushes, or syringes.

A device for rapidly spraying range cattle is described. Its capacity is 30 animals per hour, at a cost of 5 cents per head for labor and material.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor*.

Investigation of the cattle foods of California, M. E. JAFFA (*California Sta. Bul. No. 100, Feb. 12, 1893, pp. 7*).—This is the first bulletin on the subject of cattle foods issued by the station, and is to be followed by others. It contains a popular discussion of the constituents of feeding stuffs, their digestibility, feeding standards, etc.; and analyses made at the station of *Lathyrus sylvestris*, oat hay, alfalfa hay, burr clover, wild hays, wheat bran, middlings, and linseed meal. Some of these analyses are compared with the average composition of American feeding stuffs.

Analyses of a number of California-grown feeding stuffs are given below, together with the calculated amounts of digestible ingredients in 100 pounds of material:

Composition of California feeding stuffs.

	Composition.						Amount digestible in 100 pounds.				Potential energy in one pound.	Nutritive ratio.
	Moisture.	Ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Crude fat.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.		
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Calories.*	
Lathyrus sylvestris (green)	63.48	3.18	8.18	9.76	13.77	1.63	6.23	0.98	5.27	8.94	422	1: 2.4
Lathyrus sylvestris (hay)	10.00	7.83	20.16	24.05	33.94	4.02	15.32	2.41	13.94	22.06	1,070	1: 2.7
Oat hay, first quality	10.38	6.75	8.31	23.85	47.91	2.80	4.74	1.34	13.83	29.70	594	1: 9.9
Oat hay, second quality	9.80	7.24	6.57	25.75	48.54	2.10	3.74	1.00	14.93	30.09	949	1:12.7
Burr clover hay	11.25	6.91	10.50	26.19	44.92	2.23	5.99	1.29	11.79	27.90	942	1: 7.1
Wild hay (*Eleocharis palustris*)	11.55	7.66	5.69	22.27	51.18	2.65	2.89	1.06	11.36	31.73	900	1:15.7
Wild hay (*Atropis californica*)	10.10	6.82	5.30	27.34	48.44	2.00	2.65	0.80	13.94	30.03	901	1:17.3

"So far as examined, where representative samples have been used, the California products compare quite closely with those of the Eastern States."

Composition of fodders and grains, H. SNYDER (*Minnesota Sta. Bul. No. 27, Feb., 1893, pp. 43–49*).—The maximum, minimum, and average composition are given for 18 samples of wheat, 16 of wheat flour, 8 of wheat germ, 6 of wheat shorts, 5 of wheat bran, 8 of corn, silage, 5 of corn kernels, 4 of corn-and-cob meal, 4 of barley, 5 of oats and 4 of peas, together with a single analysis of flaxseed, germ meal, gluten meal, wild buckwheat, corn stover, corn tops, corn butts, corn fodder, corn silage, wheat and oat straw, rape (dried leaves and whole plant), and hay of clover, timothy, millet, alfalfa, and peas. With the exception of the wheat, the grains and fodders were grown upon the experiment station farm during the seasons of 1891 and 1892.

The starch and dextrin (soluble starch) were separately determined in each sample [of wheat and flour]. The flour was made from eight of the eighteen samples of wheat whose analyses are reported, and contains more starch and less gluten and nitrogenous matters than the original wheat. The small amount of ether soluble matter (mainly fat) is noticeable. In the wheat it will be seen that the ratio of the gluten to the starch is about 1 to 4; in the flour 1 to 6.5.

The composition of the wheat germ is extremely interesting, inasmuch as there is more nitrogenous matter in this product than in the original wheat or any of the other products. * * * On the average there is more water in the flour and each one of the products than was present in the original wheat. Whether this is true in general yet remains to be seen. Wheat starch is quite hygroscopic, and without doubt many of the discrepancies in the weighings of large quantities of wheat are due to the differences in the amounts of hygroscopic moisture present. * * * In the wheat 97 per cent of the nitrogen is in the form of gluten and other albuminoids; in the flour 98. Practically all of the nitrogen is in the form of gluten and albuminoids. This is not in accord with statements found in many chemical journals and books, but it must be remembered that the chemical methods for the determination of nitrogen have been materially improved within comparatively recent years.

The per cent of starch and dextrin in the wheat ranged from 62.4 to nearly 68, with an average of about 65. The starch and gluten make up about 90 per cent of the total composition of the dry organic matter of the wheat. The extremes reached in the composition of these wheats were marked by the Ladoga wheat. It contained the most mineral matter, fiber (woody material), and the least gluten of any of the wheats examined; and the same was true of the Ladoga flour.

Digestion experiments, H. SNYDER (*Minnesota Sta. Bul. No. 26, Jan., 1893, pp. 40*).

Synopsis.—Experiments with milch cows on the digestibility of a ration of pea silage and wheat bran, and with pigs on the digestibility of corn, shorts, barley, peas, bran, and various combinations of these foods. The value of the manure from these different rations is given.

Pea silage and wheat bran (pp. 3–19).—The peas were cut while green and placed in a compartment of a silo, which was opened early in March, 1892. The silage was sweet and in good condition, and was generally relished by cows, especially when mixed with bran, timothy, or corn. A ration consisting of 34 pounds of pea silage and 12 pounds

of wheat bran was fed to two milch cows for twenty days to determine its digestibility. The excreta were collected during the last five days. Full tabulated data are given from which the following summary of the coefficients of digestibility of the ration is deduced:

Coefficients of digestibility found for pea silage and bran.

	Dry matter.	Ash.	Organic matter.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.
Bess	75.5	61.4	77.0	80.6	79.6	56.9	82.0
Sully	76.9	63.9	77.8	81.2	80.3	58.9	82.3

The yield and the composition of the milk of each cow is also given.

From the same number of pounds of food Bess gave 10 pounds more milk than Sully; but the 108 pounds of milk from Bess contained less fat and solids than the 98.5 pounds given by Sully. Sully's milk, although 10 pounds less, produced 0.89 pounds more fat. * * *

In the case of Bess 8.58 per cent of the solid matter of the food was returned in the solid matter of the milk, while with Sully 9.85 per cent was returned. * * *

The per cent of nitrogen returned by each cow was somewhat less than the amount in the food. Sully returned nearly 95 per cent, while Bess returned a little over 91 per cent, indicating that none of the vital functions had been carried on at the expense of the muscles of the body without due compensation from the protein of the food. Nearly the same per cent of ash was returned by each cow. * * *

About 82 pounds of dry matter were burned up in the body of each cow, equivalent to a little over 16 pounds per day. * * *

The more complete digestive work of Sully, with no tendency to gain in flesh or retain the nitrogen of the food, gave better milk returns than the less complete digestive work of Bess, with a tendency to gain in weight and to retain more of the nitrogen of the food. * * * Of the total nitrogen in the food, about 20 per cent was returned in the dung, from 20 to 25 per cent in the milk, and over 50 per cent in the urine. Nearly all of the phosphoric acid was returned in the dung.

The results show that the urine is of greater commercial value than the dung, since half of the nitrogen of the food was returned in the urine and only a fifth in the dung. The nitrogen in the urine is soluble and more available as plant food, while the nitrogen in the dung is largely insoluble, as the determinations of albuminoid nitrogen show. The value of the manure depends mainly upon the nitrogen, and this is contained largely in the urine.

Digestion trials with pigs (pp. 20–40).—Digestion trials are reported with barley, corn, shorts, peas, and bran, fed separately, and with rations of barley and shorts, corn and shorts, corn and bran, and peas and bran. One pig was used in each trial. The pigs used ranged in weight from 135 to 275 pounds. The data of the trials, including analyses of the feeding stuffs fed, are tabulated.

Following is a summary of the coefficients found:

Summary of digestion coefficients.

Kind of grain.	Dry matter.	Ash.	Ether extract.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Albuminoids.
Corn and shorts	84.2	4.15	87.3	82.4	48.3	90.3	81.3
Corn	89.7	....	77.6	89.9	48.7	93.9	89.0
Shorts	79.0	4.15	....	76.0	48.0	88.0	....
Barley and shorts	77.6	6.09	78.9	77.7	34.0	85.9	77.1
Barley	80.1	5.39	67.3	81.4	48.7	86.6	81.0
Shorts	74.0	6.63	....	71.0	25.0	85.5	....
Corn and bran	71.7	2.46	70.1	78.3	30.6	78.2	78.1
Bran	53.7	....	65.4	75.8	26.9	56.0	....
Peas and bran	79.0	3.35	74.5	82.7	57.6	85.0	85.0
Peas	89.8	4.00	....	88.6	77.9	95.0	90.0
Bran	77.8	3.01	78.1	74.4	39.1	75.0	75.8

From these coefficients and the composition of the feeding stuffs a table is calculated showing the pounds of digestible food ingredients in 100 pounds of each of the materials tested.

Manurial values of feeding stuffs (pp. 20–38).—From the data obtained in the above digestion trials with pigs calculations were made of the fertilizing value of the food consumed by each animal per day, together with the corresponding values of the excreta. The basis used for the valuation was nitrogen 17 cents, phosphoric acid 7 cents, and potassium oxide 4 cents per pound.

Value of manure from pigs on different foods.

Kind of food.	Food per day.	Nitrogen retained in body.	Fertilizer value of the food consumed.	Value of the urine per day.	Value of the dung per day.	Total value per day.	Initial weight of pigs.
	Pounds.	*Per cent.*					*Pounds.*
Barley and shorts	$9\frac{5}{7}$	35	\$0.043	\$0.016	\$0.012	\$0.028	254
Barley	6	06	.020	.010	.006	.016	275
Corn and shorts	$5\frac{1}{7}$	00	.021	.012	.006	.018	235
Corn	$6\frac{1}{2}$	22	.016	.010	.003	.013	258
Peas and bran	$4\frac{4}{7}$	28	....	.010	.007	.017	135
Corn and bran	$4\frac{1}{7}$	25	....	.008	.006	.014	141

The value of the manure returned in one day, it will be seen, depends upon the quantity and kind of food and the per cent of nitrogen retained in the body. The dung returned from a hundred pounds of the barley is more valuable than that returned from a hundred pounds of the corn. The addition of shorts to either barley or corn very noticeably increased the value of the dung.

Nitrogen balance (pp. 39, 40).—This is given for the barley and shorts, shorts and corn, barley, and corn in a table showing the nitrogen in the food and in the excreta, the amount of nitrogen retained in the body, the amount of digestible protein in the food, and the changes in live weight.

When no nitrogen was retained in the body there was a slight loss of weight, and when only a small quantity of nitrogen was retained a slight gain resulted. An increase in weight was accompanied by an increase of the nitrogen stored up in the body. With about half a pound of digestible protein per day in the food the pigs fed on barley, and corn and shorts made no appreciable gains, but when the diges-

tible protein was increased to three quarters of a pound per day, and the other compounds increased in the same ratio, the pig made a fair gain; and when the amount was still further increased to nearly a pound per day the pig gained 19 pounds in a week. A little over half a pound of nitrogen per week was passed in the urine of each animal, and this occurred whether the animal was gaining or losing in weight. The amount of nitrogen carried off in the dung varied according to the amount of indigestible nitrogen to be disposed of in the food. The nitrogen in the urine represents nearly all of the digestible nitrogen of the food that was used in the body for mechanical purposes, while the nitrogen in the dung represents mainly the indigestible nitrogen of the food.

When the digestible nitrogen in the food was increased above the amount required to maintain the animal nearly all of this increase was stored up in the body.

To the farmer these results mean that for every 6½ pounds of barley or corn fed to a pig weighing 250 pounds about 6 pounds are used up mechanically in the body and only about half a pound goes to make flesh. The chief benefits that are derived from the food comes from the small amount that is in excess of that required for maintenance. These figures show how unprofitable it is to deal out small or unbalanced rations for fattening mature animals since a certain amount must go for supplying fuel and doing work, and nearly all above this amount is made into flesh. It is economical to feed a liberal ration.

Digestion experiments, F. E. EMERY and B. W. KILGORE (*North Carolina Sta. Bul. No. 87d, Nov., 1892, pp. 53*).—Detailed accounts are given of experiments on the digestibility of pulled corn fodder (cured corn leaves), crimson clover hay, cowpea vine hay, soja bean silage, corn silage, raw cotton seed, roasted cotton seed, and cotton hulls and rations of corn silage and cotton-seed meal, and cotton hulls and cotton-seed meal. These trials were with sheep, goats, steers, and cows. The animals were fed in a preliminary period of at least eight days and the excreta collected for six days following. The coarse fodders were fed alone and in quantities to suit the appetites of the animals. The raw and roasted cotton seed were each fed in connection with corn silage. Average samples were taken of each feeding stuff used, and the analyses of these, together with the amounts of food eaten and refused and analyses of the excreta, formed the basis for the detailed tables. The coefficients of digestibility found are summarized in the table below, in which "under the heading of total sugars is presented all the cold water extract substances capable of reducing Fehling's copper solution, and is really more than the true sugars, while under the heading of starch is included all copper-reducing bodies obtained by treating the residue from the total sugars with 150 c. c. of water and 4 c. c. of hydrochloric acid in an Erlenmeyer flask, with a reflux condenser, on a water-bath for twelve hours. This of course, is not all starch, for other bodies besides starch have no doubt been converted into sugars, but duplicate determinations gave fairly concordant results, showing pretty constant conversion power of the acid."

Coefficients of digestibility.

	Total dry matter.	Crude ash.	Crude protein.	Albuminoids.	Crude fat.	Nitrogen-free extract.	Crude fiber.	Total sugars.	Starch.	Undetermined carbohydrates.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Pulled corn fodder:										
Goat	54.85	15.67	68.76	63.50	65.42	57.08	54.27	100.00	63.45	42.38
Sheep	56.22	11.29	43.15	41.56	60.59	60.65	67.04	100.00	69.98	42.58
Crimson clover hay:										
Goat	59.44	53.44	68.52	59.39	43.72	69.34	42.57	100.00	65.66	67.85
Sheep	65.00	53.65	69.75	61.06	53.96	73.63	54.82	100.00	70.67	72.17
Cowpea-vine hay:										
Goat	59.28	53.89	65 14	48.52	53.71	70,61	41.24	100.00	61.88	71.05
Sheep	59.18	36.40	63.94	46.56	46.36	70.71	44.59	100.00	65.49	69.02
Soja-bean silage:										
Black goat	52.26	47.09	71.31	60.06	66.43	45.88	47.13	100.00	63.23	0.42
Gray goat	65.79	66.31	80.19	72.15	77.30	58.16	62.47	100.00	73.59	......
Corn silage:										
Cow	53.17	26.89	34.41	26.39	66.04	60.53	43.17	100.00	55.16	61.43
Raw cotton seed:										
Cow, first trial	69.31	48.32	70.02	66.62	87.00	49.23	85.91	100.00	76.54	14.92
Cow, second trial	62.94	38.28	65.68	60.49	87.20	50.00	65.07	100.00	74.73	27.37
Roasted cotton seed:										
Heifer	58.40	......	49.56	46.25	74.95	52.99	69.32	100.00	77.80	8.34
Steer	53.46	......	44.34	42.21	68.51	49.77	62.51	100.00	78.03	8.62
Cotton-seed hulls:										
Cow 1	44.97	21.52	......	......	89.33	45.68	47.28	100.00	50.24	38.91
Cow 2	35 92	27.14	24.61	......	80.61	40.30	27.42	100.00	40.13	38.91
Gray goat	37.38	21.90	......	......	88.98	28.01	47.25	100.00	44.37	4.01
Black goat	41.02	9.00	2.04	......	81.59	33.51	50.70	100.00	49.73	10.55
Average of four trials	39.82	19.89	6.75	......	85.13	36.88	43.14	100.00	46.11	23.09

As will be seen from the [above], the sugars were in all cases completely digested. The coefficients of digestibility of the "undetermined carbohydrates" of corn fodder, soja-bean silage, rations of raw and roasted cotton seed and corn silage, raw and roasted cotton seed, and cotton hulls are much lower than the corresponding ones for starch for the same fodders and rations, but with the remaining fodders and rations there was very little difference in the digestibility of starch and "undetermined carbohydrates."

The coefficients show [pulled] corn fodder to be superior in feeding value to timothy or redtop, and almost equal to clover hay.

A ration for a 1,000-pound horse or mule would be 5 or 6 bundles of fodder with 21 ears of corn per day for light work.

[The cowpea hay was from vines cut so late] that the leaves were fast falling and the coarse stems too ripe for good hay. * * * Comparison with the other analyses show this hay to be low in content of ash, protein, and fat, and to have a greater amount of crude fiber. * * * The animals ate it nearly as well as they did the pulled corn fodder and the clover hay. * * * Soja-bean silage has been fed in our stable long enough to give assurance of its value. For milch cows it has seemed to arrest the natural decline in yield for a time, when fed after a long period on corn silage. This may have been partly due to other causes, as changes in grain fed and approach of spring. Fed to a bull of a little under 1,000 pounds weight for over five weeks, at the rate of 45 pounds per day, the bull made a slow but steady gain in weight. * * *

Comparison of the digestibility of raw cotton seed with that of roasted cotton seed shows the dry matter, protein, albuminoids, fats, and fiber of the roasted seed to be less digestible, while the nitrogen-free extract is more digestible in the roasted than in the raw seed. The analyses of raw and roasted seed reveal little difference in the composition of the two beyond a slight increase in fat and fiber in roasted over raw seed and a decrease in nitrogen-free extract. These experiments show a clear and heavy loss of digestible material from roasting, to say nothing of the increased cost of roasting the seed. * * *

[Considerable variation was noticed in the amount and the proportion of protein digested from the cotton-seed hulls by different animals.] This is most likely due to bile compounds, mucus, and other intestinal products not belonging to the undigested food residue proper. Extraction of the feces with ether, alcohol, hot water, and cold limewater failed to lower the nitrogen in them. The coefficients for dry matter and nutrients other than protein make a first-rate showing for cotton hulls. A low protein coefficient would be expected in a coarse fodder having so wide a nutritive ratio.

Four trials are reported on the digestibility of rations of corn silage and cotton-seed meal, and five trials of mixtures of cotton-seed meal and hulls, containing 1 pound of meal to 4, 6, and 7 pounds of hulls, respectively. Calculations made from the trials with mixtures of cotton seed meal and silage "indicate that the highly nitrogenous cotton-seed meal very favorably affects the digestibility of the corn silage. The total dry matter of the combination of silage and meal was more digestible that silage alone and meal."

There has been a gradual increase in the digestibility of the rations of hulls and meal with the increased addition of meal. The digestibility of the dry matter of the 1 to 7 ration was 45 per cent, of the 1 to 6 ration 49 per cent, of the 1 to 4 ration 53.5 per cent. This increase here, as with the rations of silage and meal, is in excess of the average between the digestibility of hulls alone and of meal, as obtained from the rations referred to. * * *

It would seem, therefore, in the light of the foregoing experiments, that a still narrower ration of cotton-seed hulls and meal could often be advantageously fed for economic production of beef, milk, or work, as it is believed that a still larger amount of digestible nutrients would thus be obtained than are shown in the preceding rations of hulls and meal.

From the analyses of the feeding stuffs given in the bulletin and the coefficients of digestible food in these experiments, calculations are made of the amounts of digestible food nutrients in 100 pounds of the several feeding stuffs and rations.

Comparative digestive power of sheep and goats, and of cows and goats for the same food (pp. 48 and 49).

The digestion experiments on corn fodder, crimson clover hay, and cowpea-vine hay, with one goat and one sheep on each, furnish data for comparing the digestive powers of sheep and goats for these three fodders, while experiments on cotton-seed hulls with two goats and two heifers furnish data for making like comparisons for goats and cows. Combining the coefficients for the sheep and cows for the four fodders, we have data for comparing the digestive powers of sheep and cows with goats for the four fodders. There is practically no difference in the amounts of dry matter digested by goats and sheep and by goats and cows from these fodders. Making comparison, however, of the goats and sheep on the individual nutrients, the goats digested more protein, practically the same amount of fats, and less nitrogen-free extract and fiber than the sheep. In comparison with the cows on cotton-seed hulls, the goats digested, on an average, less protein, practically an equal amount of fats, less nitrogen-free extract, and more fiber.

Feeding silage vs. dried food, J. W. SANBORN (*Utah Sta. Bul. No. 19, Oct., 1892, pp. 11*).—A comparison is given of corn silage and field-cured corn fodder for steers and sheep, and of grain alone *vs.* grain and silage for pigs. The silage and corn fodder were made from the same field of corn. The corn fodder stood in the field ten to seventeen days.

"It was placed in the barn too quickly and went through the heating process."

Lots of three steers each were fed dry corn fodder, dry hay, and silage, respectively. From December 23 to April 4 the lot on hay gained 200 pounds, the lot on corn fodder 46 pounds, and the lot on silage 109 pounds. The dressed weight of the lots fed on corn fodder and silage were nearly equal. Analyses of the carcasses showed that the silage-fed lot contained slightly less water than the other.

Two lots of sheep of three each were fed from December 21 to April 4. The gains were small, averaging 12 pounds per sheep for the lot on silage and $16\frac{1}{2}$ pounds for the lot on corn fodder. "In flesh the silage-fed lot contained 11 per cent more water and 11.2 per cent less fat."

In the trial with pigs one lot was fed all it would eat of the grain ration of oats, peas, barley, and wheat, and the other a restricted grain ration with silage. The first lot received more than twice as much grain as the latter. The amount of dry matter eaten in the trial (December 22 to April 8) was 1,009 pounds for the lot on grain alone, and 648 pounds for the lot on grain and silage. It is not surprising, then, that the lot fed grain *ad libitum* made somewhat the larger gain.

The author believes that "the balance of results are against silage, even when compared with heated air-dried corn fodder."

Calf feeding, C. F. CURTISS (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 614–617*).

Synopsis.—Linseed meal, ground oats, and a mixture of corn meal and ground flaxseed were compared as supplements to separator skim milk. Like amounts of grain were fed to all. The gain was largest and the cost per pound of gain least with the mixture of corn meal and flax meal.

Six heifer calves, 3 Holsteins and 3 Shorthorns, were fed in lots of two each from June 14 to August 13 the following rations: Lot 1, linseed meal and skim milk; lot 2, ground oats and skim milk; and lot 3, a mixture of nine parts corn meal and one part ground flaxseed, and skim milk. The grain was gradually increased from 1 pound per head at first to 2 pounds. The milk was separated in a Baby separator and the skim milk fed while warm. Each calf had 20 pounds of skim milk per day. They were in a pasture the early part of the trial and later received green peas and oat forage. They ranged in weight from 132 to 223 pounds at the beginning of the trial. The results for the 60 days are as follows:

Gain in weight and food eaten by calves.

	Total gain.	Cost of food per pound of gain.	Digestible nutrients in food.			
			Protein.	Carbohydrates.	Fat.	Nutritive ratio.
	Pounds.	*Cents.*	*Pounds.*	*Pounds.*	*Pounds.*	
Lot 1: Linseed meal and skim milk	$115\frac{1}{2}$	5.4	72.60	97.6	2.1	1: 1.4
Lot 2: Ground oats and skim milk	128	4.4	52.14	106.8	4.9	1: 1.6
Lot 3: Corn meal, ground flax, and skim milk	$155\frac{2}{3}$	3.0	52.02	118.5	7.9	1: 2.7

[Considerable variation was noticed in the amount and the proportion of protein digested from the cotton-seed hulls by different animals.] This is most likely due to bile compounds, mucus, and other intestinal products not belonging to the undigested food residue proper. Extraction of the feces with ether, alcohol, hot water, and cold limewater failed to lower the nitrogen in them. The coefficients for dry matter and nutrients other than protein make a first-rate showing for cotton hulls. A low protein coefficient would be expected in a coarse fodder having so wide a nutritive ratio.

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	Total gain.	Cost of food per pound of gain.	Digestible nutrients in food.			
			Protein.	Carbohydrates.	Fat.	Nutritive ratio.
	Pounds.	*Cents.*	*Pounds.*	*Pounds.*	*Pounds.*	
Lot 1: Linseed meal and skim milk	115½	5.4	72.60	97.6	2.1	1: 1.4
Lot 2: Ground oats and skim milk	128	4.4	52.14	106.8	4.9	1: 1.6
Lot 3: Corn meal, ground flax, and skim milk	155¾	3.0	52.02	118.5	7.9	1: 2.7

The cost of food is based on the following prices: Linseed meal 1¼ cents, ground oats 1 cent, corn meal ½ cent, and ground flax 1 cent per pound, and skim milk 15 cents per 100 pounds.

"The protein of these rations does not seem to have been the controlling factor in determining gain. On the contrary, we find the greater influence exerted by fat and carbohydrates, a principle in feeding that I believe always prevails where protein is fed in excess as in quite narrow rations."

The nutritive ratios given are all very much narrower than those generally recommended for cattle at this stage of growth. Evidently the pasture grass and oat and pea forage was not taken into account in calculating the nutritive ratio.

Rations for dairy cows, F. W. WOLL, (*Wisconsin Sta. Bul. No. 33, Oct., 1892, pp. 22*).—The basis of this bulletin is the reports received from sixteen farmers and dairymen in the State in reply to a circular letter sent out in the spring of 1892, asking for information as to the rations fed to dairy cows during the preceding winter. The object was to find out what rations were being fed by successful farmers, and what, if any, improvements could be made in them. These rations are given in detail, and calculations based on the average composition and cost of the feeding stuffs in the State are made of the digestible nutritive ingredients furnished by each, and the cost of the ration per day. The rations are also compared with the standards of Wolff and Kühn. A summary of 15 of these rations is given, as follows:

Components of rations for milch cows fed by fifteen Wisconsin dairymen.

Feeding stuff.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV	XV.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Corn silage	30	27	40	50	50	35	30	45	60	.....	30	32	.....	25	35
Clover silage	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22	.....	.....	.....
Clover hay	.....	6	5½	.....	5	.....	.....	5	.....	.....	.....	2½	5	.....	8
Timothy hay	.....	.....	.....	.....	5	.....	.....	.....	7	15	.....	2½	.....	.....	3
Mixed hay	6½	.....	.....	10	.....	5	11	.....	.....	.....	.....	.....	.....	.....	.....
Marsh hay	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	.....
Fodder corn	.....	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16	.....	.....
Corn stalks	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13	.....	.....	20	.....
Barley straw	.....	.....	.....	.....	.....	.....	.....	.....	.....	14½	.....	.....	.....	.....	.....
Oat straw	.....	1½	.....	.....	.....	.....	4	.....	6	.....	.....	.....	.....	.....	.....
Wheat bran	.....	4	10	4½	3	2¼	4	8	.....	4	3¾	6	5⅓	.....	3⅓
Wheat middlings	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....
Corn meal	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	3	.....	.....	.....	.....
Corn-and-cob meal	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oats	5	.....	.....	5½	.....	.....	2	.....	3	3	3¼	4	2⅔	.....	2⅓
Cotton-seed meal	.....	.....	.....	.....	.....	1⅓	.....	.....	.....	.....	.....	3	.....	.....	.....
Linseed meal	3	4	2	2	1	.....	2	2	3	½	.....	.....	.....	3	2⅓
Malt sprouts	.....	.....	.....	.....	.....	4	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pea meal	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....
Cost of ration, cents	17.7	14.6	15.2	10.4	14.6	11.9	15.1	14.2	16.5	14.8	13.9	19.1	11.0	13.4	15.1

Summary of nutrients in rations fed by fifteen Wisconsin dairymen.

Herd No.	Number of cows in herd.	Breed.	Organic matter in daily ration.	Digestible matter. Protein (N × 6.25.)	Carbohydrates.	Fat.	Total	Nutritive ratio.	Annual product per cow. Milk.	Butter.	Cost of ration.
			Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Cts.*
I	60	Shorthorns and Red Polls	19.61	1.80	10.66	0.70	13.16	1:6.9	6,000	260	17.7
II	27	Grade Jerseys*	27.59	2.09	14.45	0.75	17.29	1:7.7	5,500	320	13.7
III	17	Guernseys	22.64	2.46	11.26	0.76	14.48	1:5.3	6,143	.....	15.2
IV	18	Holsteins	25.18	2.11	13.58	0.79	16.48	1:7.3	(†)	.....	19.4
V	30	Holsteins	27.12	1.79	12.49	0.70	14.98	1:7.8	7,000	300	14.6
VI	16	Grade Jerseys‡	28.00	3.39	15.14	0.96	19.49	1:4.8	......	300	15.3
VII	29	Grade Jerseys and natives	29.96	2.22	15.12	0.76	18.10	1:7.6	......	300	15.1
VIII	45	Jerseys and grade Jerseys	29.00	2.97	14.83	0.96	18.76	1:5.7	4,000	.....	14.2
IX	31	Grade Jerseys	34.81	2.64	18.82	1.03	22.49	1:8.0	......	.....	16.5
X	8	Shorthorns	26.29	1.33	13.50	0.46	15.29	1:10.9	......	175	14.8
XI	28	Jerseys	25.85	1.80	14.70	0.75	17.25	1:9.1	......	350	13.9
XII	30	Guernseys	24.50	2.87	11.56	0.96	15.39	1:4.8	7,500	400	19.1
XIII	7	Jerseys and natives	22.47	1.75	12.06	0.57	14.38	1:7.6	4,500	210	11.0
XIV	49	Holsteins and grade Holsteins	25.29	1.77	13.54	0.61	15.92	1:8.4	......	.....	13.4
XV	25	Jerseys	24.00	2.28	11.99	0.78	15.05	1:6.0	......	.....	15.1
Average for 15 herds			26.09	2.22	13.58	0.76	16.56	1:6.9	5,806	291	15.3
Standard ration according to Kühn			20–33.5§	1.5–2.4‖	12.14	0.4-0.7	13.9–17.1	1:5.5 8.0	......	.....	.....
Standard ration according to Wolff			24.0	2.5	12.5	0.4	15.4	1:5.4	......	.....	.....

* Average of two rations.
† 6,000–16,000 pounds.
‡ Average of four rations.
§ Total dry matter.
‖ Albuminoids.

A study of the above tables will disclose many points of interest to the student of cattle feeding. It will be noticed that the cost of the ration for a cow in Wisconsin ranges between 11.0 and 19.4 cents, and the average cost is 15.3 cents; this may be taken to represent what it costs to keep a good cow a day under our conditions, when she is in full flow of milk and receiving a full ration.

The cost of the feeding stuffs stated makes no allowance for the value of manurial ingredients.

A comparison is made between the average composition of these fifteen rations and that of eight rations reported by the New York State Station (Report for 1889, p. 91; E. S. R., vol. I, p. 226), and one ration reported by the Connecticut State Station (Report for 1891, p. 99; E. S. R., vol. III, p. 764.)

In all three cases there is a very striking similarity between the rations, and although there are some differences for the herds within each State, the average rations fed in each of the three States are practically the same. This means that, under conditions existing in our country, practical business farmers, with the question of dollars and cents before them, and with no scientific hobby of any kind as their guide, have found that a cow ought to receive such daily rations as will contain about 2.2 pounds digestible protein, 13.3 pounds digestible carbohydrates, and 8 pounds digestible fat, in order to produce a large flow of milk at the most profit; such rations will have a nutritive ratio of about 1:6.9.

It would appear then that our cows need less protein and more carbohydrates and fat in their ration than is recommended by Wolff.

In conclusion, the author gives formulas for six rations calculated to furnish digestible nutrients in the amounts stated in the above averages.

The teachings of the bulletin may briefly be stated as follows: Keep only cows that respond to good feeding; feed liberally, but not to waste; select such feeding stuffs as will supply a fair quantity of protein; raise and feed more oats and clover; use bran, shorts, and oil meal whenever needed and when obtainable at a reasonable price.

Experiments in feeding buttermilk to pigs, D. A. KENT and O. C. VAN HOUTEN (*Iowa Sta. Bul., No. 19, Nov., 1892, pp. 618–621*).

Synopsis.—A comparison of churn washings with buttermilk and of soaked corn with shelled corn, and corn *ad libitum*. The buttermilk proved decidedly superior to the churn washings, and corn *ad libitum* gave better gains than 2 pounds of soaked corn or 4 pounds of shelled corn.

Four lots of three pigs each, averaging from 200 to 265 pounds per pig at the beginning of the trial, were fed to compare soaked corn, a limited amount of shelled corn, corn *ad libitum*, and no corn, and also to compare washings of the creamery churn with buttermilk. In the first period of twenty days one lot received churn washings alone, and the other three lots received, in addition to the churn washings, 2 pounds of soaked corn, 4 pounds of shelled corn, or corn *ad libitum*. The pigs on churn washings alone lost one-half pound per day each. The others all gained from one-half to 1¼ pounds per day, the largest gain being by the lot on corn *ad libitum*.

In a second period immediately following and lasting about two months, the food was the same for all the lots except that buttermilk was fed in place of churn wash water. The lot on buttermilk alone gained well at first, but lost later on. As before, the lot fed corn *ad libitum* made the largest gain, followed by the lot fed 4 pounds of shelled corn.

In a third period of forty-eight days, the lot which had previously received no corn was given ear corn and buttermilk *ad libitum*. They increased rapidly in weight, especially the first month.

Feeding experiments with horses, E. B. VOORHEES and L. A. VOORHEES (*New Jersey Stas. Bul. No. 92, Feb., 1893, pp. 28*).

Synopsis.—A comparison is given of dried brewers' grains and oats, pound for pound, for work horses. The trial was made on eight horses heavily worked during summer. The results, as shown by the weight and the general condition of the animals, indicated that the brewers' grains were fully equal to the oats, pound for pound. The cost of the brewers' grains was considerably less than that of the oats, so that by substituting them, the cost of the daily ration was diminished about 5 cents per day per animal. Data on the composition of the rations, on the methods of drying brewers' grains, and on the output of brewers' grains are given.

"In 1890 a number of farmers of the State, acting on the suggestion of the station, substituted dried brewers' grains for oats in a ration for work horses. The dried grains were cheaper, pound for pound,

than the oats, and being richer in the valuable nutrients, protein and fat, permitted of a very material reduction in the cost of the ration. The work performed by the animals was quite as great, and their health and vigor quite as good, as when oats constituted the main part of the ration."

To further study the relative values of oats and dried brewers' grains for work horses an experiment was made in coöperation with the city horse railway on eight horses which were found, on examination by a veterinarian, to be sound and in vigorous health. These were divided as nearly as possible into two equal lots. Beginning June 12 the horses in lot 1 received a ration containing dried brewers' grains, and lot 2 a similar ration containing oats. August 12 the rations were reversed, and September 11 both lots were fed a like ration consisting of oats, ground corn, and oats and hay. This was continued until October 1, when lot 1 was placed upon the dried brewers' grain ration, and lot 2 on the oats ration, and so fed until the close of the month.

The grain mixtures consisted of 2 pounds of wheat bran, 4 pounds of hulled corn, and 8 pounds of oats or dried brewers' grains. Like quantities of hay were fed with each ration. The two heavier horses in each lot were given 15 pounds of food, and the others 13½ pounds each per day. The rations were weighed out by an employee of the station. The constituents in the daily rations (15 pounds) were as follows:

Composition of daily rations of horses.

	Protein.	Fat.	Carbohydrates.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	
Dried brewers' grains ration	2.57	0.58	9.85	1:4.4
Oats ration	1.76	0.57	10.17	1:6.6

The dried brewers' grains ration was, therefore, the richer in protein, containing 46 per cent more protein than the oats ration. This ration contained 13 pounds and the oats ration 12.5 pounds of digestible dry matter.

The work performed by the horses was practically identical, consisting of at least four trips of about 6 miles each daily, although on some days the trips were increased to five and sometimes six, but in all such cases the food of the horses in the experiment was increased proportionately.

The analyses of the feeding stuffs used and the live weights are fully tabulated. A summary of the gains and losses for each animal for each period is given as follows:

Changes in live weight of horses by periods.

Periods.	Lot.	Food.	Gain (+) or loss (—) in weight during period. No. 1.	No. 2.	No. 3.	No. 4.	Average gain (+) or loss (—) per horse.
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
July 12-Aug. 11..	1	Dried brewers' grains........	—15	— 15	—10	+15	— 6.25
	2	Oats..........................	0	0	+50	+40	+22.50
Aug. 12-Sept. 11 .	1	Oats..........................	+15	— 10	+25	—15	+15.00
	2	Dried brewers' grains........	0	+ 50	—25	—15	+ 2 50
Sept. 12-Sept. 30..	1	Stable ration*	—35	0	—45	0	—20.00
	2	Stable ration*	—40	— 50	—20	+ 5	—26.25
Oct. 1-Oct. 31.....	1	Dried brewers' grains........	+80	+ 30	+80	+50	+60.00
	2	Oats..........................	+60	+115	+40	+40	+46.70

* Oats, ground corn, and oats and hay.

The results of this experiment indicate that (1) in both rations the nutrients furnished were sufficient to maintain the weight of the animals under average work; (2) on the whole, a pound of dried brewers' grains was quite as useful as a pound of oats in a ration for work-horses; (3) rations which contained at least as much of fat and protein, but less of carbohydrates than the standard, maintained and even increased the weight of the animals; and (4) a ration that contained less fat and protein but more of carbohydrates than either of the others [stable ration] resulted in a decrease in weight.

There was evidently a waste of protein in the dried brewers' grains ration, since the oats ration, containing 30 per cent less protein but practically the same fat and carbohydrates, gave relatively as good results.

At the close of the experiment the veterinarian reported as follows: "I have watched the horses closely from the beginning to the end of the experiment and have failed to discover any ill effects from the use of dried brewers' grains. The horses fed the grains have been as healthy as I have ever known them to be."

Economy of the dried brewers' grains ration (pp. 14-18).—The cost per ton of the feeding stuffs used in the above experiment was as follows: Hay, $18; wheat bran, $22; corn, $22; oats, $30, and dried brewers' grains, $18. The cost per day of the dried brewers' grains ration was 19.4 cents, and of the oats ration 24.3 cents per horse.

The substitution of dried brewers' grains for oats resulted not only in a maintenance of the weight of the animals under equivalent work, but in a saving of 4.9 cents per day per horse, or 25 per cent of the cost of the ration. This saving, though appearing small in itself, means considerable in the aggregate; if applied to the forty horses at the car stables, it would represent a saving of $1.96 per day, or over $700 per year, a sum sufficient to pay the interest on a capital of $12,000. * * *

Another point which should be regarded, especially by farmers who make the exchange, is the relative content and value of the fertilizer constituents contained in these feeds. A ton of oats sold from the farm carries away, on an average, 37 pounds of nitrogen, 15 of phosphoric acid, and 12 of potash. A ton of dried brewers' grains will bring to the farm 77 pounds of nitrogen, 19 pounds of phosphoric acid, and 2 pounds of potash; a gain to the farm, by the exchange, of 40 pounds of nitrogen and 4 of phosphoric acid, and a loss of 10 pounds of potash, or a net gain of $6.19 on the basis of their fertilizing values. The gain would be proportionately the same if the feeds were used on the farm, since under uniform conditions of feeding the same relative amounts of the constituents would be retained in the manure. At the same cost per ton for the two feeds, therefore, there would be a considerable gain in fertility by a pound-for-pound substitution of the dried brewers' grains for the oats.

The rations commonly fed to work-horses by farmers and in Government work are cited and criticised. "They are too rich in carbohydrates, and in their preparation the character and composition of the grains used are disregarded, thus giving widely different proportions of the various nutrients for the same work. * * * In what are regarded as the best rations the fat approaches 0.6 of a pound, and the protein 1.8 pounds per day, while the carbohydrates range from 10.17 to 14.68 pounds."

Formulas for four different rations are given, together with the amounts of protein, fat, and carbohydrates which they contained.

Composition of wet and dried brewers' grains and methods of drying (pp. 18–27).—Analyses are given of a number of samples of wet and dried brewers' grains collected from different sources, and of the liquid expressed from the wet grains. In the dried grains examined the water varied from 8 to nearly 12 per cent, the protein from 18.7 to 26 per cent, and the fat from 5.6 to 7.4 per cent; but the difference in composition is believed to be due to differences in the raw material rather than to differences in the methods of drying.

"By the operation of pressing, 100 pounds of wet grains, containing on the average 24.79 pounds of solid matter and 75.21 pounds of water, was reduced to 57 pounds, consisting of 23.51 pounds of solid matter and but 33.49 pounds of water; or, in other words, in the pomace was contained 95 per cent of the total dry matter, associated with less than one-half (44.5 per cent) of the water originally in the grains. The liquor, therefore, contained the losses, consisting of 1.28 pounds of matter dissolved or suspended in 41.72 pounds of water."

The solids in solution were found to consist largely of the more soluble ingredients, as sugar, non-albuminoids, and potash. The loss, however, is not considered significant, as it does not diminish the value of the grains.

Estimated output of dried brewers' grains (pp. 27, 28).—There are at present four different plants engaged in drying the grains from eastern breweries. These all employ different processes, though, as has been shown, the resultant products do not differ widely in chemical composition. The total calculated capacity of these plants aggregates about 15,000 tons of dried grains annually. Their actual production for the past year, however, has been very much less, probably not more than 6,000 tons. It is believed that this output will be largely increased before long, as works are being extended and new plants erected.

The production of capons, S. CUSHMAN (*Rhode Island Sta. Bul. No. 20, Dec., 1892, pp. 40, figs. 23.*—To investigate the claims made for caponizing, the author made quite a thorough canvass of the subject, including experiments on fowls at the station, and reports the results in the present bulletin. The large establishments near Philadelphia and in New York where caponizing is practiced were visited, and the operation learned from experiments. In the hands of an experienced

operator the operation is very rapid, the loss of fowls from death is small, and the "slips" few. In the localities visited the operation is largely performed by experts who make it their business for the season and drive about the locality. An appointment is made for their visit, and the fowls to be operated upon are confined and fasted for about 48 hours.

One operator visited caponized 28,000 birds the past season. A frequent charge, where the distance is not too great, is 3 cents per head.

To be in demand, season after season, a man must kill few birds during the operation, and there should be few slips or imperfect capons among them. A rapid operator constantly at the work makes less slips than a more careful man who does not keep in practice, while the quicker it is done the less trying it is to the bird. Many in that section [Burlington and Cumberland Counties, New Jersey] who are skillful operators, but do not follow the business and get out of practice, find it cheaper to pay the professional his small fee than to do it themselves.

The author describes five separate experiments in caponizing various breeds of cockerels. Fowls weighing 2 to 2½ pounds were taken for the operation.

Of the 80 caponized on the place the first season (1891), there were 5 lost, as follows: Of the first four, 1; of the next eleven, none; of the next three, 2 (Langshan, too large and tough); of the next six, none; of the next four, none; and of the 52 cut by myself and the students, none at the time of operation, although two died afterward from the wound not having properly healed. The 52 were cross-breed birds having considerable Plymouth Rock and Wyandot blood. They were of medium size and became fit for market in shorter time than those with which the experiments were performed. They were not weighed during growth.

During the past season experiments in this line have been continued. About 100 birds have been operated upon. Dorkings, Brahmas, Houdans and their crosses have been very satisfactory material for the operating table, while Indian Games and their crosses have been more difficult to do. Some Plymouth Rock stock is hard to caponize, their thighs being close against the ribs and so near the place where the opening should be made that it is hard to do the work without laming the bird.

Following is a summary of the author's studies:

Caponizing was easily learned and successfully performed by following book directions, but more quickly and satisfactorily by witnessing the operation.

Birds apparently suffered but little pain from the operation and the per cent of loss was small.

Birds thus changed grew larger in frame, matured later, became quiet and contented, did not crow or fight, and their flesh remained soft and tender.

Those weighing 2 pounds or less were most easily and safely caponized, but the larger the birds, provided they had not commenced to crow and their combs had not developed, the more quickly they recovered.

The only birds that died under the operation were those that had developed combs.

The old Chinese tools, when their use was understood, were found most satisfactory of all.

Of the Brahma-Cochin cross, it was seven months before the capons equaled the uncastrated birds in weight, and they did not average one pound heavier in ten months.

The Langshan rooster, although weighing but one-sixth of a pound more than the

Langshan capon at the commencement of the experiment, kept ahead in weight for seven months.

The Plymouth Rock capon equaled the roosters in weight in less than two months and gained on them the rest of the season, but did not average more than three-quarters of a pound heavier at any time.

The Indian Game capons were five months in catching up with the roosters, and were not a quarter of a pound heavier eight months after the operation.

The Brahma Cochins gained the least during the first year, but made the largest and heaviest birds at eighteen months.

The Langshan was less affected by the operation, but was larger at the time it was performed.

The Plymouth Rocks recovered less readily, but they were operated upon when the weather was warmer, fifteen days later than the Langshan.

Indian Games and their crosses were harder to do and should be taken when younger.

These experiments show less gain in weight as the result of caponizing than we were led to expect by published accounts. The tender flesh and the ability to quickly take on fat seemed to be the only gain of importance.

During the exhibition of the Rhode Island Poultry Association, the ten Brahma Cochin capons and the five Plymouth Rock capons gained, while the roosters of each lot lost in weight. The Plymouth Rock capons made the greater gain, while the Plymouth Rock roosters also showed the greater loss. The birds exhibited in pairs lost more than where there were five or more in the coop.

The plan of spraying the wound immediately after the operation with an antiseptic solution requires further study to get definite results.

By the use of a physician's head mirror, we were able to operate quite satisfactorily by lamplight.

Those wishing to produce only a limited number of capons will find it more profitable to secure the services of an expert, if one can be found within a reasonable distance, than to buy instruments and attempt the work themselves.

A review is given of the Boston poultry market for 1891 and 1892, illustrated directions for performing the operation, and preparing capons for market, and descriptions of the various kinds of caponizing instruments. The station offers free instruction in caponizing to any resident of the State.

[About the first of January] there is hardly a limit to the demand for capons weighing 8 pounds or over, and "Philadelphia" capons bring 20 cents and Western 18 cents.

Large birds sell the best. The heavier the better. When 10-pound birds bring 22 cents, 25 cents will be given for 12-pounders, and 28 cents for those weighing 14 pounds. Capons killed at ten or eleven months of age are preferred, as they get coarse and "soggy" if kept until twelve months old or longer. March-hatched capons should be killed in January. The birds bought in January are placed in freezers and gradually sold during the winter. * * *

Frozen capons can not compare with those freshly killed in spring and early summer. * * *

Judging from these results and a study of the markets the best chance of profit by the production of capons would be in caponizing late chicks that ordinarily would be fit for market as broilers or roasters when the prices are the lowest, and too old to sell as tender chickens in January and February. Cockerels that were hatched in June, July, or August, especially if of the large early maturing kind like Plymouth Rocks and Wyandots crossed on Brahmas or Langshans, castrated in September, October, and November, and marketed in March, April, May, and June, when they would have reached their best, would be the most profitable and bring the highest

price. Such birds are often sold alive by the pound very low in the city markets or by those who have no room to winter them. Farmers who have cheap food, who are far from shipping points and therefore kill and ship all at one time in cold weather, might profitably make capons of all roosters. Those who keep birds until maturity for their own table should do the same. There will be little gained by caponizing birds in May or June if they are to be marketed by Christmas, as the birds have not sufficient time to fill out.

Live stock and poultry, J. G. LEE (*Louisiana Stas. Bul. No. 21, 2d ser., Feb., 1893, pp. 617–620*).—Brief statements are made concerning breeds of cattle, sheep, and swine on the station farm.

A record of the eggs laid by the station breeds of hens showed that the Brown Leghorns led for three successive years; they were followed by Light Brahmas, Langshans, Plymouth Rocks, Buff Cochins, and Minorcas.

VETERINARY SCIENCE AND PRACTICE.

Actinomycosis bovis, or lump jaw, N. S. MAYO (*Kansas Sta. Bul. No. 35, Dec., 1892, pp. 99–112*).—This bulletin deals with statistics showing the prevalence of actinomycosis, with the symptoms of the disease, age of animals attacked, location, growth, and morbid anatomy of the tumor, and with the cause of the disease. The fungus which causes the tumor is discussed, as also the mode of infection and treatment, and the use of affected animals as human food.

Over three hundred attempts to grow the actinomyces in various culture media were unsuccessful. The fungus showed great resistance to decomposition, material two years old assuming a fresh appearance as soon as soaked.

Guinea pigs, one dog, two steers, and two heifers were inoculated with material from a tumor. Thirty-seven inoculations were made with pus from an actinomycetic tumor and none reproduced a tumor. Of the fourteen inoculations made with neoplastic tissue, containing the actinomyces in a growing state, eight produced actinomycetic tumors.

The following conclusions are drawn:

Actinomycosis bovis or lump jaw of cattle is a parasitic disease caused by the growth in the tissues of a fungus called actinomyces. It appears as a lump or tumor, usually in the region of the head or neck, and may grow to a large size. This tumor usually discharges a yellowish pus, which contains portions of fungus known as actinomyces. It is not transmissible from one animal to another by means of the actinomyces as they are found in the pus. It can be transmitted to other cattle by inoculating with a piece of tissue from the tumor which contains the organism in a growing state. The actinomyces which cause this disease are probably a degenerate form of some fungus which grows naturally upon feeding stuffs or grain. When the spores of the original fungus are taken into the animal economy, they may gain entrace to the tissues, vegetate, and produce the disease known as *Actinomycosis bovis*, or lump jaw. There is no danger of persons contracting this disease from eating the flesh of affected animals, provided the visibly diseased portion is removed.

The treatment consists in removing the tumor, either with a knife or by the use of caustics. Iodide of potash given internally may effect a cure.

Animal parasitism, R. R. DINWIDDIE (*Arkansas Sta. Bul. No. 20, Nov., 1892, pp. 3–14*).—Notes on liver rot of cattle, the lard worm (*Stephanurus dentatus*), hog itch (*Sarcoptes scabiei*, var. *suis*), and cattle ticks (*Boöphilus bovis*, Curtice, *Ixodes bovis*, Riley).

The lard worm occurs in the livers of hogs almost universally throughout Arkansas.

For hog itch, or scabies, a wash, consisting of sulphur and lime in equal parts, boiled in 20 parts of water, is recommended.

The cattle ticks obtained in the neighborhood of the station are not of the same species as those found further south. In the larval form ticks were kept alive without food for four months. "They are not killed by at least one night's exposure to a temperature of 28° F."

The life history of the tick is traced. Tobacco infusion and pyrethro-kerosene emulsion killed only those ticks that were smaller than a grain of wheat.

Some observations upon loco, N. S. MAYO (*Kansas Sta. Bul. No. 35, Dec., 1892, pp. 113–119*).—The loco disease is said to be caused by animals eating either one of two closely related plants, *Astragalus mollissimus* and *Oxytropis lamberti*, both belonging to the natural order Leguminosæ, and growing on the Great Plains. Alcoholic and water extracts of the fresh and of the dried plants produced no physiological effect on Guinea pigs. Animals eat the so-called loco plant after pastures have dried up in the fall, and having once acquired a taste for it neglect all other food. The first symptoms of the disease are general sluggishness, difficult locomotion, and trembling of the muscles. Later the animal becomes emaciated. The head and legs swell. There is evidence of brain disorder both in cattle and in horses, the latter being subject to fits. The temperature is from one half to one and one half degrees F. below the normal.

Post-mortem examinations showed a flaccid, atonic condition of the digestive system, with a large amount of serum in the abdominal cavity and surrounding the brain. These symptoms, in the author's opinion, point to malnutrition as the cause of the disease. He finds no evidence of a narcotic principle in the plants.

An animal once affected with this disease never makes a complete recovery. Animals which have acquired a taste for the plant should be kept away from it and given nourishing food rather than medical treatment.

Rheumatism in horses, T. D. HINEBAUCH (*North Dakota Sta. Bul. No. 7, Sept., 1892, pp. 15, figs. 5*).—Rheumatism in horses is believed to be a neurotic disease due to improper ventilation or feeding; 168 cases were treated by the writer in fourteen months. The death rate was 7 to 10 per cent of the animals affected. The symptoms and possible causes of rheumatism, locally called "millet disease," are fully discussed. There are full reports of three typical cases and a report of one post-mortem examination.

Texas fever experiments, R. R. DINWIDDIE (*Arkansas Sta. Bul. No. 20, Nov., 1892, pp. 14–31*).—During the summers of 1891 and 1892 14 animals were used to test the virulence of manure from infected regions, of cattle ticks from the Texas fever belt, and of the second generations of Southern ticks, hatched in the laboratory.

The animals in the pen strewn with manure appeared to be unaffected. In most cases where ticks from the South were sprinkled on cattle, Texas fever, not of a fatal type, ensued. Ticks of the second generation, bred north of the infected region, produced the disease when applied to cattle. A cow sprinkled with these last died in fourteen days with all the symptoms of an acute case of Texas fever. This was confirmed by a post-mortem examination. A calf similarly treated with Northern-bred ticks of the second generation was attacked but recovered. "In no case was any fever noticed without the presence of ticks on the body."

Texas cattle fever, J. C. NEAL (*Oklahoma Sta. Special Bul. No. 1, Oct., 1892, p. 1*).—An account of an outbreak of Texas cattle fever (splenetic fever) in Payne County, Oklahoma. M. Francis, of the Texas Station, was called in, and his report on symptoms, post-mortem appearances, and preventive and curative treatment is published. "I have had encouraging results (with calves and yearlings) from the use of internal antiseptics. * * * When the first symptoms of fever appear * * * give a tablespoonful of the following mixture in one half pint of water: Salol 4 ounces, iodol 1 ounce, benzol 4 ounces, and alcohol 12 ounces."

DAIRYING.

E. W. ALLEN, *Editor.*

Composition of dairy products, H. SNYDER (*Minnesota Sta. Bul. No. 27, pp. 50–62*).—Analyses are given of the milk of 8 cows of the station herd, taken at different times, and of samples of butter; general remarks on the constituents of milk, and the use of the lactometer and milk test in determining the character of milk; Fleischman's, and Hehner and Richmond's formulas for milk calculation; and five examples showing the distribution of milk in cheese-making from normal milk, creamed milk, and skimmed milk.

The legal standard for cheese in this State is that 40 per cent of the total solid matter of the cheese shall be butter fat. In the case of milk skimmed from 3.50 to 2.75, a removal of over 20 per cent of the fat, over 40 per cent of the total solid matter of the cheese was butter fat. In another case in which the milk was skimmed to 2.80 per cent fat, over 40 per cent of total solid matter in the cheese was butter fat. In the case of normal milk testing 3.50 per cent fat over 50 per cent of the total solid matter was fat. The fats in full milk cheese should always exceed the casein, since there is always more fat in the milk than casein and albumen, and a larger per cent of the fat recovered in the cheese than of the casein and albumen. * * *

Artificial digestion experiments were made of the nitrogenous compounds [of cheese]. The results are not reported, since it was found that the per cent of salt in

the cheeses compared was not the same, and the salt that was present in variable quantities reacted with the acid in the digestive mixture and introduced an unknown factor. In general, it can be said that the casein in well cured cheese from normal milk is nearly all digestible.

[According to the table showing the distribution of ingredients in cheese-making] the amount of fat lost in every hundred pounds of milk is about 0.3 of a pound, and is practically the same for both rich and poor milk. The per cent of the total milk fats retained in the cheese made from rich milk is greater than that made from poor milk. All of the additional fat that is in a rich milk goes into the cheese, and whether it pays, financially, to make the extra fat into cheese, depends upon the price that the cheese commands. It must be remembered, however, that a good article can not be made from poor material.

An automatic acid measure, G. E. PATRICK (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 632–636, fig. 1*).—An illustrated description is given of an automatic pipette for rapidly measuring out the acid used in the Babcock milk test, with directions for making. The apparatus was designed by the writer, and is in use at the college creamery, where it has been found very satisfactory.

Tests of dairy apparatus, W. H. CALDWELL (*Pennsylvania Sta. Bul. No. 22, Jan., 1893, pp. 20, figs. 4*).—A previous bulletin (No. 20) of the station (E. S. R., vol. IV, p. 364) detailed the results of a number of trials of the Baby apparatus No. 2. The present bulletin presents the results of similar tests made with the Victoria hand separator and two sizes of the extractor-separator, or butter extractor. Illustrated descriptions of these machines are given. Eleven separate tests were made with a 30-gallon Victoria hand separator. The average capacity of the separator was 337 pounds of milk per hour. The percentage of fat in the skim milk ranged from 0.12 to 0.27 per cent and averaged 0.19 per cent. Out of every 100 pounds of butter fat in the milk, 96.3 pounds were recovered in the cream, and 3¼ pounds remained in the skim milk.

Eight trials were made with the extractor-separator No. 2, making butter directly from the whole milk. The summarized results of these trials are given in the following table:

Tests of extractor-separator No. 2.

Date.	Speed (hundred revolutions per minute).	Temperature of milk.	Milk per hour.	Distribution of fat.			
				Skim milk.	Drainings.	Washings.	Butter.
		Degrees F.	*Pounds.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Aug. 10	68–70	56–57	696	7.18	0.28	10.30	82.24
11	68–72	56–60	665	8.79	0.30	2.83	88.08
23	72	59–60	500	7.58	0.09	0.64	91 69
24	72–80	59–60	471	9 21	0.18	1.54	89.07
25	72	60	472	9.52	0.19	0.77	89.52
Sept. 3	72*	58–60	534	10.84	0.20	1.91	87.05
5	72	58–59	448	8.62	0.35	1.38	89.65
6	70–80	60	467	8.51	0.20	3.27	88.02
Average			532	8.78	0.22	2.83	88.17
Average excluding Aug. 10 and Sept. 3			504	8.70	0.22	1.74	89.34

* Fell to 60 for a few minutes.

It will be seen that the machine showed a capacity of 500 to 600 pounds of milk per hour, and recovered on an average 89.34 pounds of butter fat for every 100 pounds of fat in the milk.

In our experience with the above machine it can not be said that we have secured a satisfactory quality of butter. The most serious defect we have noted was its lack of body. The aggregations of granules as they came from the machine inclosed large amounts of water and extracted milk, which they held very obstinately, making the butter much more difficult to work and prepare for market than butter from ripened cream. The finished butter in all cases contained a large percentage of water. As regards the matter of flavor, tastes will differ. Some among our customers preferred the butter from the extractor; others that from the ripened cream. Samples which were sent to commission merchants, they not knowing the source of the samples, were in nearly every instance condemned as lacking in flavor. A much larger proportion of salt must be worked into the granular butter to attain the same degree of saltness in the finished product.

The extractor-separator No. 4, a smaller size, was used as an extractor in four trials. The machine was run by power.

Out of every 100 pounds of butter fat in the milk 91.52 pounds were recovered in the butter, this being nearly 2 pounds better than in similar trials with the larger machine.

Not only was there this greater efficiency of the smaller machine, but in our experience the running or handling of the machine was much better, and to all appearance the butter from the small machine was of much more satisfactory quality than that from the larger size.

This same machine (No. 4) was used as a separator in six trials, in five of which the machine was run by steam power. It showed an average capacity of 386 pounds of milk per hour. The fat in the skimmed milk ranged from 0.15 to 0.22, and averaged 0.18 per cent.

On the average of the six trials, 96.91 per cent of the total butter fat in the milk was recovered in the cream.

Hints to cheese-makers, G. L. McKAY (*Iowa Sta. Bul. No. 19, Nov., 1892, pp. 627-631*).—Practical suggestions on the handling of milk in cheese-making.

AGRICULTURAL ENGINEERING.

The duty of water, L. G. CARPENTER (*Colorado Sta. Bul. No. 22, Jan., 1893, pp. 32, figs. 10*).—This is a preliminary report on observations "intended only as a step towards determining the present practice in Colorado."

Since with us in Colorado—as indeed throughout all of the arid West—the land far exceeds the water supply, the ultimate extent of our irrigated area, and therefore of our profitable agriculture, depends upon the use we make of our water. If lavishly used, our productive area is correspondingly limited; if wisely and economically used, the greater will be the area capable of supporting a population, and consequently the greater will be our public wealth. * * * The current value of water rights indicates the value of the water in the consideration of the community.

In most cases the water rights are subject to the uncertainties of the streams, and can not be absolutely relied upon to furnish water when most needed. Nevertheless, they are currently rated even in the new communities at from $10 to $15 per acre, and when the rights are certain to furnish the water the value is greater. * * * At present we have something like 1,500,000 acres under cultivation in this State. A doubling of the duty would increase the public wealth of the State from this source alone by $20,000,000 at the present estimates of water rights, and an increase of 25 per cent would mean an increase of $5,000,000 from this source alone. * * * The observations and measurements which are here reported are some of those made during the past three years in the Cache a la Poudre Valley, one of the first valleys in the State to be developed. The results are principally from the records of self-recording instruments. These were placed so as to record all the water which passed through weirs, which were so placed as to measure all the water applied to various crops. Instruments have been placed so as to measure the water applied to crops of potatoes, of alfalfa, of clover, of native hay, of wheat, and of oats. * * *

We have the record of three seasons of the amount of water used by the Cache a la Poudre Canal Company No. 2, one of the original Greeley Colony canals. From the skill of the farmers drawing water from it, and from the fact that it is one of the original Greeley Colony canals, it perhaps best represents what would be the practice of skillful farmers in the valley when water is supplied to them as they desire it. * * * The experience gained in these measures has shown the difficulties to be encountered, and will enable us to make the determinations of the future more satisfactory. But though confessedly incomplete, the importance of a more general knowledge of the subject makes it desirable to publish such results as we have.

The results, reduced to a common basis by R. E. Trimble, are given in numerous tables and diagrams.

The duty, as estimated in acres per cubic foot of water per second, may vary between wide limits, according to the method of estimation, and on the same farm and the same depth of water applied. Unless these conditions are taken into account, it is better to estimate the depth of water needed and the time through which it is necessary. There is less difference between different canals and different users than is generally considered true.

The amount of water given at one irrigation depends more upon the preparation of the ground or its conditions than upon the crop. Under Colorado conditions, irrigations of less than 6 inches in depth are rarely given.

The difference between the nominal rates of duty in Colorado and those in other countries has been partly because those of Colorado are based upon the use in June, the month of the greatest need, while those of others take the whole season or year through. When reduced to the same basis, the practice in Colorado agrees favorably with that of other countries. It would seem as probable from the measures that the average duty of 1 cubic foot per second flowing constantly, as measured at the head of the canal, is 60 to 65 acres in June to 175 to 300 for the whole season. The last represents the conditions when a reservoir is available in which water may be stored.

A diagram for determining the duty of 1 second-foot of water under different conditions is given.

STATION STATISTICS.

Organization of Idaho Station, R. MILLIKEN (*Idaho Sta. Bul. No. 1, Sept., 1892, pp. 4*).—The station was organized February 26, 1892, as a department of the College of Agriculture of the University of Idaho, under the act of Congress of March 2, 1887. The headquarters of the station are at Moscow, but field experiments will be carried on at Grangeville, Idaho Falls, and Nampa. The farms obtained for this purpose were unimproved and only preparatory work was undertaken in 1892.

Proposed work of Idaho Station, R. MILLIKEN (*Idaho Sta. Bul. No. 2, Dec., 1892, pp. 7*).—A brief statement of the objects of experiment station work, with special references to the needs of such work in Idaho.

Publications of the North Carolina Station from March, 1877, to September, 1892 (*North Carolina Sta. Bul. No. 87, Sept. 15, 1892, pp. 20*).—A subject list of all the publications of the station. A considerable number of these publications were included in the list published in E. S. R., vol. III, p. 960.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Investigations into the nature, causation, and prevention of Texas or Southern cattle fever, T. SMITH and F. L. KILBORNE (*Bureau of Animal Industry, Bul. No. 1, 1893, pp. 301, plates 10, figs. 7*).—The subjects treated in this bulletin are: The nature of Texas cattle fever, period of incubation, symptoms, pathological changes, causation or etiology, the microörganism, the transmission of Texas fever by means of the cattle tick, the life history of the cattle tick, the relation of the cattle tick to the period of incubation of Texas fever and to the infectiousness of southern cattle, immunity and protective inoculation, diseases resembling Texas fever on other continents, and practical observations and conclusions. The appendix contains full notes on all cases of Texas fever investigated.

"The destruction of red corpuscles is the essential phenomenon of Texas fever from which all the various pathological processes take their origin." Numerous examples are given in which this disease caused a reduction in the number of red corpuscles in a cubic millimeter of blood from about 6,000,000 to the neighborhood of 2,000,000. From one sixth to one eighth of all the red corpuscles usually circulating in the body are destroyed in 24 hours at certain stages of the disease.

A mild, rather prolonged, usually non-fatal type of Texas fever was also observed in these experiments. It is largely an autumn disease, and manifests no symptoms of Texas fever to the unaided eye. In this mild, non-fatal form the rate of destruction of blood corpuscles is less rapid than in the acute form.

The microörganism which causes this destruction is thus described:

When blood is drawn from the skin during the [acute form of Texas] fever and examined at once with high powers (500 to 1,000 diameters, Zeiss apochrom., 2^{mm}, oculars 4 and 8) certain corpuscles will be found containing two pale bodies of a pyriform outline. One end of each body is round and the body tapers gradually to a point at the other. They vary somewhat in size in different cases, but the two bodies in the same corpuscles are as a rule of the same size. They are from 2 to 4 μ in length and 1.5 to 2 μ in width at the widest portion. Their tapering ends are directed toward each other and usually close together; their rounded broad ends may occupy various positions with reference to each other. They may be seen together with the axes of the bodies nearly parallel or they may be far apart, the axes forming a straight line. * * * The bodies themselves have a homogeneous,

pale appearance, contrasting markedly with the inclosing red corpuscles from which they are sharply outlined. There is no differentiation into peripheral and central zone, and no granular appearance of the body. Several slight variations in the appearance of these bodies at different times have been noted. The smaller forms are as a rule homogeneous; the larger forms are very frequently observed to be provided, in the rounded end of the pyriform body, with a very minute spherical body probably not more than 0.1 to 0.2 μ in diameter, which contrasts dark with the body itself. In several cases it manifested a brilliant luster with very high powers. In the largest pyriform bodies there was seen in the center of the enlarged end a somewhat larger round or oval body which seemed to take the place of the smaller body or else be associated with it. This second body was from 0.5 to 1 μ in diameter. It changed its appearance with the focus. At a low position of the objective the parasite appeared dark with a light round spot in the enlarged end. At a higher position of the objective the inner body appeared dark, inclosed in the lighter pyriform outline. One or both of these bodies were observed in some of those forms undergoing amœboid changes. * * *

While only a few parasites may circulate in the blood, the infection may reach 50 per cent or even more in the internal organs. The parasites as they appear in the capillaries differ somewhat in form from those in the circulating blood. * * * Of the internal organs the kidneys usually contain the largest numbers; not infrequently from 50 to 80 per cent of all the corpuscles are infected.

These parasites were observed in a free state (due to the disintegration of the infected corpuscles) in the blood from the heart muscle and in the kidneys. None were found free in the circulating blood.

The mild (usually autumnal) cases of the disease * * * are characterized by the presence of the smaller stages of the parasite. While the pyriform bodies are not entirely absent they are very rare. * * *

In the mild type we have from 5 to 50 per cent of the red corpuscles in the circulating blood infected for a period of from one to five weeks. * * * In the fresh preparations of blood this small stage of the parasite is as a rule invisible. Rarely we may observe it on the very border of the corpuscle as a round pale spot about 0.5 μ in diameter, which does not change its place. When dried films of blood are stained in alkaline methylene blue the parasites appear as round coccus-like bodies from 0.2 to 0.5 μ in diameter and situated within the corpuscle on its border. They sometimes appear as if situated on the border but outside of the corpuscle. As a rule only one is found in a corpuscle. In many cases a division of the coccus-like body into two parts could be clearly made out. The separation was noticeable as a paler line and a constriction at either end similar to the division of certain micrococci.

Inoculation experiments, in which a comparatively small quantity of blood from diseased cattle was introduced under the skin of healthy susceptible cattle, resulted in a severe and even fatal infection.

The experiments with ticks at the experiment station of the Bureau, near Washington, D. C., covered four years. In 1889, "in the field containing the ticks only, and in which Southern cattle at no time entered, all three exposed adult natives took the disease. In the field containing Southern cattle from which the ticks had been picked no disease appeared. Finally, in the two fields which contained Southern cattle and ticks together, three out of six natives became diseased. * * * [In 1890] ticks were hatched artificially and placed on cattle with the result that Texas fever appeared in every case."

These results were further confirmed in 1891 and 1892. In 1892 in duplicate experiments susceptible cattle were exposed to North Carolina animals, which latter were kept free from ticks by picking off daily all ticks that could be found. Thus none were allowed to propagate. This exposure without ticks induced not a single case of Texas fever. "The conclusion from these experiments that the tick is necessary to cause infection in Northern cattle may be regarded as demonstrated."

The life history of the tick explains why natives placed in an infected inclosure at various intervals before the appearance of the young ticks will all contract the disease at the same time, and why Southern cattle which receive no more accessions of young ticks become harmless in twenty-five to thirty days after leaving their tick-infected pastures.

In one or two years at the North, adult Southern cattle did not lose their immunity against Texas fever. Two calves from Southern parents, but born near Washington, when exposed to Southern animals, developed mild cases.

These experiments demonstrate the important fact that one attack of Texas fever does not necessarily protect the animal from a second attack. Of the eighteen [recovered] cases seven may be said to have remained practically unaffected during the second exposure. Of the remaining eleven three died during the second exposure. * * * If a preliminary mild attack could be induced by artificial means the fatal effect of a second attack might be averted.

Perhaps the simplest manner of producing a mild, usually non-fatal, attack is to expose cattle on pastures which have been infected with ripe, egg-laying ticks at some specified time in the fall. * * *

In the latitude of Washington we found in 1889 the middle of September a convenient time for the infection. In more northerly latitudes the exposure should be correspondingly earlier. Cattle exposed in this way take Texas fever invariably, but the mortality is practically zero. Such animals may die of a second attack during the succeeding summer, but a second mild exposure during the following autumn may furnish a sufficient protection. Inasmuch as the recovery from even severe attacks of Texas fever is usually complete and not followed by any permanent debility, such mild attacks would not be likely to cause any permanent injury to the exposed animals.

Cattle may be deprived of ticks on a large scale without the use of any disinfection if the following plan be adopted: Two large fields in a territory naturally free from cattle ticks are inclosed. The tick-bearing cattle are put into the first inclosure and kept there about fifteen days. They are then transferred to the second inclosure for the same length of time. Thirty days after the beginning of their confinement they may be considered free from infection. The cattle drop the ticks as they ripen in the inclosures. By being transferred to a second (or even a third) inclosure they are removed from the possible danger of a reinfection by the progeny of the ticks which dropped off first. It is evident that such inclosures can only be used once a season.

Conclusions.—(1) Texas cattle fever is a disease of the blood, characterized by a destruction of red corpuscles. The symptoms are partly due to the anæmia produced; partly to the large amount of débris in the blood, which is excreted with difficulty, and which causes derangement of the organs occupied with its removal.

(2) The destruction of the red corpuscles is due to a microörganism or micro-parasite which lives within them. It belongs to the protozoa and passes through several distinct phases in the blood.

(3) Cattle from the permanently infected territory, though otherwise healthy, carry the micro-parasite of Texas fever in their blood.

(4) Texas fever may be produced in susceptible cattle by the direct inoculations of blood containing the micro-parasite.

(5) Texas fever in nature is transmitted from cattle which come from the permanently infected territory to cattle outside of this territory by the cattle tick (*Boöphilus bovis*).

(6) The infection is carried by the progeny of the ticks which matured on infected cattle, and is inoculated by them directly into the blood of susceptible cattle.

(7) Sick natives may be a source of infection (when ticks are present).

(8) Texas fever is more fatal to adult than to young cattle.

(9) Two mild attacks or one severe attack will probably prevent a subsequent fatal attack in every case.

(10) Sheep, rabbits, Guinea pigs, and pigeons are insusceptible to direct inoculation. (Other animals have not been tested.)

(11) In the diagnosis of Texas fever in the living animal the blood should always be examined microscopically if possible.

Report upon investigations relating to the treatment of lumpy-jaw, or actinomycosis, in cattle, D. E. SALMON (*Bureau of Animal Industry, Bul. No. 2, Feb., 1893, pp. 90, plates 8*).—A statement of the controversy between the officials of the Bureau of Animal Industry and the Illinois Board of Live Stock Commissioners regarding animals affected with lumpy-jaw; the official correspondence on this subject; estimates of the loss suffered by owners of condemned cattle; a citation of authorities to show that actinomycosis is not transmitted from bovines to man; experiments to test the contagiousness of actinomycosis; cost and effect of the iodide treatment; success of individuals using iodide of potassium; notes on treatment and post-mortem examinations; and illustrations showing diseased animals.

In 1892, 185 animals affected with actinomycosis in various stages of the disease were treated in Chicago by the Bureau of Animal Industry. To test the contagiousness of actinomycosis, 21 healthy cattle were tied in the stable between the diseased animals, so that the former were forced to eat food soiled with the discharges from the tumors, and to inhale the breath from the diseased cattle. At the end of four months these 21 head were slaughtered, when post-mortem examination showed that all were unaffected.

The diseased cattle were given iodide of potassium internally.

In treating actinomycosis in cattle with iodide of potassium the dose should never exceed 1 gram (one-fourth dram) for every 100 pounds live weight, the proper dose being from 8 to 12 grams (2 to 3 drams), according to the size of the animal and the extent of the lesion. This dose may be given from five to six days, when the animal will show slight symptoms of iodism, viz., discharge of thick mucus from the nose and excretion of tears. The manure will become rather dry, but that is easily repaired by giving a dose of Glauber salts and some bran mash. This will restore the appetite, and two days after the last dose is given the animal will be ready for another week's treatment, and so on until a cure is effected. If these precautions are taken, no ill effect will result from the treatment, and if properly fed the animal will gain in condition uninfluenced by the medicine. There is, however, a great difference as to the individual effect of the medicine on animals, but any farmer who

takes an interest in seeing his stock doing well will easily perceive when it is time for him to stop and give the animal rest for two or three days.

The medicine is best administered dissolved in water and given by means of a slender, long-necked bottle. * * *

One dose of medicine is dissolved in about a pint of water, the steer is seized by the nose to hold up the head, and the contents of the bottle is emptied into the mouth without fixing or securing the tongue in any way. * * *

The most convenient way is to have the medicine, which is easily dissolved, prepared in a concentrated solution of the strength 1 to 2 (2 drams of the solution to contain 1 dram of iodide of potassium). The drug must be dissolved in distilled or rain water, as otherwise a precipitate will form from the salts present in common water. With such a concentrated solution and a measuring glass it is easy to measure out the exact dose for every animal and pour it into the wine-bottle, half filled with common water. * * *

The amount of medicine used in a single case ought never to exceed 1 pound, equal to an expense of $3. * * * When the tumor is not connected with the bony tissue, but is lying loose in the connective tissue under the skin, a favorable result may be expected in from two to five weeks, according to the size of the tumor and to the susceptibility of the individual toward the effect of the medicine. It is not necessary to continue the treatment until the tumor has disappeared completely, but it may be stopped when it has shrunk to about one-third of its original size, and the remainder will usually disappear without further treatment.

November 29, 1892, two lots of cattle experimented upon were killed. Each lot contained forty head, the one consisting of cattle that were supposed to be completely cured, while the second lot included all the old chronic cases, where a successful result could not be expected in the time limited for the experiment. * * *

The forty cattle which were supposed to be cured proved to be so with the exception of two, which had small actinomycetic tumors in the lung containing living actinomyces. In nine other cases traces of the disease were found at the place where the tumors had been located, but these traces were so insignificant, ranging in size from a pin's head to a bean, that they did not amount to anything.

The first lot were all in good condition, some of them very fat, and the greater part of the second lot also were in a very satisfactory condition, only a few of them being really poor. A noteworthy fact is that only two out of each lot had actinomycetic lesions in the internal organs, in all cases in the lungs. This would hardly have been the case if the cattle had not been treated. In some cases a few small nodules, in size from a millet seed to a pea, containing a cheesy, greenish detritus mass, were found in the wall of the small intestines, but a microscopical examination of these lesions gave negative results with regard to actinomycosis. The final result of the investigation was that out of the first lot 38 were passed as fit for human food, while the two cases affected with actinomycosis in the lungs, were condemned. Of the other 40 only 5 were passed and 35 condemned, though many of them were big fat steers with the lesion located on the jaws and no internal lesions of any kind. The tumors on the greater part of these did not contain any pus, and the granulomatous tissue had undergone a fibrous metamorphosis, and subsequently did not contain any actinomyces possessed with regenerative power.

Of the 80 cattle slaughtered on November 29, 43 were pronounced practically cured and fit for food by the inspectors of the Bureau of Animal Industry, and 25 were pronounced to be completely cured and fit for food by the State veterinarian. Considering that this number included 40 of the very worst cases taken for experiment, the result can not but be considered as extremely satisfactory. If the conclusions of the Bureau inspectors are taken, the result is a cure of 53 per cent of the affected animals.

December 2, 20 more head of cattle were killed. These had been stabled in the same barn as the rest and had been treated from three to six weeks each with proper

intervals. * * * They were all pronounced cases, but only the soft tissues were involved. The lesions were about the same as those in the first lot, hard, fibrous tumors, the size from a goose egg to a child's head, located in the loose connective tissue under the skin in the submaxillary or sublaryngeal space. They all recovered completely, and at the post-mortem examination no traces of the disease were found except in two cases, a hard, fibrous induration in the skin, where the tumors had been. They were all passed as fit for human food.

With 85 animals which had been under treatment, and which were slaughtered January 27 and 28, the results were as follows:

The number found on post-mortem examination to be cured was 68, or 80 per cent of the whole number. Of the 17 condemned as not cured there were internal lesions of actinomycosis in the lungs of three. About 4½ per cent of this lot of animals, therefore, showed internal lesions.

Of the whole number under treatment, which were killed and examined, viz, 185, there were found to be cured 131, or about 71 per cent. The number showing internal lesions was 7, or 3.8 per cent of the animals in the experiment.

This result is extremely gratifying, and proves that a large proportion of the advanced cases of actinomycosis are curable by the internal administration of iodide of potassium. If taken in the early stages of the disease, there is no doubt that 85 or 90 per cent would yield to this treatment.

The more destructive locusts of America north of Mexico, L. BRUNER (*Division of Entomology, Bul. No. 28, pp. 40, figs. 21*).—This bulletin, which is supplementary to Bulletins Nos. 25 and 27 of the Division of Entomology (E. S. R., vol. III, pp. 55 and 907), contains illustrated accounts of nineteen species of Acridiinæ "which have occurred in this country in such numbers as to attract particular notice, or which, from their known habits and relationships, are liable to become injurious. Each species is fully described in all its stages, so far as these are known, and its range and particular habits are given."

The following species are described: American locust (*Schistocerca americana*), large green bush-locust (*Acridium shoshone*), small green locust (*A. frontalis*), long-winged forest locust (*Dendrotettix longipennis*), differential locust (*Melanoplus differentialis*), robust locust (*M. robustus*), two-striped locust (*M. bivittatus*), detestable locust (*M. fœdus*), devastating locust (*M. devastator*), narrow-winged locust (*M. angustipennis*), herbaceous locust (*M. herbaceus*), Rocky Mountain locust (*M. spretus*), lesser migratory locust (*M. atlanis*), red-legged locust (*M. femur-rubrum*), lead-colored locust (*M. plumbeus*), *Pezotettix enigma*, pellucid-winged locust (*Camnula pellucida*), long-winged locust (*Dissosteira longipennis*), and pale-winged locust (*D. obliterata*).

The bollworm of cotton, F. W. MALLY (*Division of Entomology, Bul. No. 29, pp. 73, plates 2*).—A report on an investigation of the cotton bollworm (*Heliothis armigera*), in continuation of that presented in Bulletin No. 24 of the Division of Entomology (E. S. R., vol. II, p. 746). The subject-matter is arranged under three general heads: Habits and natural enemies, remedies, and bacteriological experiments with insect diseases. Tabulated data are given for observations on the

amount of injury caused by the bollworm to corn and cotton. In the fields examined the damage to cotton is estimated at 18 per cent, which is probably much higher than the average. The damage to corn is comparatively slight under ordinary conditions. Among other food plants of the bollworm mentioned in this article are tobacco, tomatoes, peas, beans, and wild ground cherry (*Physalis pubescens*). Observations on the insect in its different stages and on parasites and other natural enemies are given. A number of insects, the ravages of which are often mistaken for those of the bollworm, are briefly described. Experiments with lights and with poisoned sweets are reported, which confirm previous conclusions regarding the inefficiency of these means of repression. Aqueous decoctions of pyrethrum having failed to destroy the bollworm, cold and hot oil extracts of this insecticide were tried. The emulsified hot-oil extract was much more effective than any other preparation of pyrethrum, but whether this preparation can be made practically useful is doubtful. Experiments with corn as a trap crop again showed that this was a reasonably satisfactory means for materially decreasing the ravages of the bollworm on cotton.

The plan to be recommended to the planter for using the trap-corn method of protecting his cotton against bollworm injury may be summed up as follows: When planting the cotton leave vacant strips of five rows for every twenty-five of cotton to be planted in corn. At the earliest possible time plant one row of this with an early maturing sweet corn. It should not be drilled in too thickly, since only a minimum number of plants and ears is desired. During the silking period of this corn frequent careful examinations must be made as to the number of small white or brownish banded eggs, hardly larger than a pinhead, found upon them. As soon as no more fresh white eggs are found each morning, the silks and ends of the ears should be cut away and fed or burned in order to destroy the young worms and the eggs. A few eggs may be on the leaves of the plants, and since no more growth is to be made, they also should be cut and taken from the field. * * *

The next planting should be three rows of dent corn, drilled in late enough to bring the silking period about the first of July or a little later. These rows catch immense numbers of eggs and larvæ, but should be left to mature, in order that the natural enemies which parasitize the eggs and prey upon the larvæ may not be destroyed. Furthermore, the cannibalism previously discussed, which occurs in this corn under such crowded conditions, reduces the number of worms reaching maturity to a minimum, and these can well be allowed to escape if the natural enemies be saved thereby. To trap these escaped individuals, the fifth and last row of the vacant strips should be planted to sweet corn at a time calculated to make it reach full silk about August 1, when the moths begin issuing again. This expedient allows the planter to save the second planting as a crop. The corn produced in this way is large enough in quantity to pay for the expense of cultivation and management, and the sacrifice made in cropping the five rows with corn instead of cotton. * * *

If the first two plantings are well managed, the number of the earlier broods will be so reduced that the August brood will not be capable of inflicting great injury, and in less infested regions the third planting may even become superfluous.

It is not necessary or advisable to crop the entire plantation with corn and cotton as recommended. The end will be attained if 5-acre strips of alternate corn and cotton be planted for every fifty acres of cotton.

The bacteriological experiments described in this report are preliminary in their nature, and have thus far given only suggestive results.

Distribution and consumption of corn and wheat (*Division of Statistics, Report, Mar., 1893, pp. 16*).—Notes and tabulated data regarding the crop of corn and wheat in the United States in 1892, the stock on hand March 1, 1893, the amount consumed in the locality where the crop was grown, and the amount put on the market.

Report of the statistician (*Division of Statistics, Report No. 102, n. ser., Mar., 1893, pp. 75-95*).—This includes the following articles: Agriculture in Alaska, foreign official crop estimates, European crop report, wheat crop of the world, and freight rates of transportation companies.

The wheat crop of the world for the year 1892 is summed up as follows:

Wheat crop of the world in 1892.

Continents.	Bushels.
North America	560,548,549
South America	47,549,418
Europe	1,312,017,878
Asia	356,371,776
Africa	34,384,193
Australasia	37,096,221
Grand total	2,347,968,035

Climatology of the cotton plant, P. H. MELL (*Weather Bureau, Bul. No. 8, pp. 68, charts 6, map 1*).—This monograph is intended to be simply "an introduction to the study of cotton and its climate." The data which it contains have been collected from "numerous United States Government reports and publications, the files of the *Commercial and Financial Chronicle*, many agricultural papers and magazines, and books relating to the cultivation of cotton in the United States and foreign countries." The subject is discussed under the following topics: History of the cotton plant and its species—origin of certain varieties, origin of green seed cotton, the extent of the cotton belt, soils best adapted to cotton culture; a general discussion of those countries where cotton is cultivated to any extent—West Indies, British India, Mexico, Australia, Brazil, Argentine Republic, and Egypt; the general climatic features prevailing in the southern United States during the preparation of the land for the planting of the seed—three regions of the cotton belt defined; the climate of the seed-planting season—soil temperatures, germinating temperatures; the growing period of the plant and its weather conditions; character of the weather best suited for the production of fiber during its process of formation; the picking season and its weather; comments on years of good and poor crops; and discussion of temperature charts.

The bulletin is illustrated by charts showing the temperature of the summer and winter months in the northern, middle, and southern portions of the cotton belt, and by a map adapted from the Tenth U. S. Census, vol. v, showing the extent of the cotton belt in 1892.

Climatic features prevailing during the preparation of the land for the planting of the seed.—The winters of the South are seldom severe, and the temperature rarely reaches zero except in the more northern latitudes of the cotton region, and not often even there. It is a well recognized fact among cotton planters that those portions of the country where the changes of temperature are sudden and the fall reaches zero during every winter and sometimes frequently during the same winter, will permit of too short a period between frosts to enable the cotton plant to perfect its growth and mature its fruit. A careful comparison of [the tables of temperature for from ten to twenty-one years with the map showing the area of the cotton belt] will show that wherever the altitude or latitude causes the temperature to range low during the winter and spring months the cultivation of cotton is correspondingly reduced to a minimum.

The climate of the seed-planting season.—The heavy frosts in the South have generally ended by April 15, and there is little danger of the young cotton plant becoming killed if it is planted so as to germinate about May 1. It is customary, therefore, to put the seed in the ground from April 1 to May 10, the time depending largely upon the locality in the cotton belt. With the exception of the extreme South the cotton that is planted before April 15 is apt to become reduced in its vitality by cool nights that prevail during the first half of April. In most sections of the cotton belt light frosts, with occasional killing frosts, frequently retard the growth of vegetation during the first weeks of April, particularly in the northern limits of the region. It is, therefore, customary in those portions of the belt to delay the planting until the first week in May so as to escape this period of cool weather. * * *

The seasons of rain are so distributed throughout the spring months as to keep the atmosphere and soil in a condition generally suited for the full development of the young plant, and that causes the roots to take a deep hold of the soil and the tap root of the subsoil preparatory to contending against the drouths of summer. A very wet spring will cause the plant to form numerous surface roots, to the great sacrifice of the tap root and those that tend downward. Under these conditions the dry season that usually prevails during the summer months will soon cause the plant to wither and shed its "squares," because of the dry condition of the surface soil in which it is forced to live, and in which it must secure the moisture required for its growth. * * * Experience has taught that the rains must be distributed during the spring and early portion of summer while the plant is young and while it is in its blooming state, so as to keep the soil in the condition best suited to yield up its food elements to the rapid demands of the growing limbs, leaves, and buds; but at the same time there must be ample sunshine, because the cotton plant loves the * * * sun, and during its entire life must have an extra quantity of warm rays. It thrives best in that climate where the atmosphere is well warmed by the almost vertical rays of the sun. * * *

In the middle section of the cotton belt, 46 days out of 100 produce cloudy weather, while 54 days are entirely clear. The [tabular record] shows that 32 days in 100 throughout the middle portions of the belt are likely to produce rain during the spring of the year. * * *

By May 1 cotton planting has become general throughout the entire area of the cotton belt. After the close of the second week in May frost is not likely to occur, and, although there may be a few cool nights, the cotton-plant in its young, tender condition stands a very fair chance in all sections of the country under consideration. By a glance at the table of temperatures for May we will see that the mean

minimum ranges above 52° at all stations, and at the majority it is above 60°. The minimum temperature, even at the extreme northern stations, never falls below 35°, and at 25 out of 31 stations furnishing continuous records the minimum is never lower than 40°.

Soil temperatures.—Soil temperatures furnish interesting data for comparison with air temperatures in the study of the subject of the climatology of plant growth. * * * It is observed that under the influences of the occurrence of high temperatures and the generally prevailing fine weather after April 20 the soil becomes rapidly warmed and the seed quickly germinates and is generally very well started above the surface of the ground by the middle of May. The seed usually takes from five to twenty days to come up, if the soil is kept comparatively warm and the rains have been sufficient to supply the needed moisture.

The growing period of the plant and its weather conditions.—This period might be properly termed the season from "chopping out" to the appearance of the first boll. In the central portions of the cotton belt this time is generally from June 1 to August 1. The first bloom opens early in June and the first boll forms early in August. During this period in the life of the plant there must be a large supply of sunshine and only so much moisture as will furnish the plant with what it needs, and at the same time not make the soil so damp as to cause too rapid multiplication of surface roots nor cause too great a growth of what farmers term "weed"—that is, rapid development of stalk and branches to the detriment of flowers and fruit. The atmosphere must not be very dry, but there must be that degree of moisture present that will readily become absorbed by the soil at night in the shape of dew, with occasional good showers through the season. The surface soil must be often stirred during this growing period so as to permit of free circulation of air through the soil, the penetration of the warm sun's rays, and the condensation of moisture from the atmosphere as it circulates over the soft land at night and in the cool early morning. In this manner much of the moisture required by the roots will be secured, although rains may not be frequent, and at the same time an ample supply of sunshine and warmth will give the young buds vigor and cause them to open promptly and bring forth healthy, well-developed bolls.

Experience has shown that the above conditions are required during the growing season to produce the best results in cotton culture. Now let us see what are the actual climatic conditions prevailing in the cotton belt during the months of June and July, and note in what respects they comply with the requirements and in what points they fail. To bring out these features, tables taken from the files of the Weather Bureau have been prepared. A careful examination of these tables will present the striking fact that the weather conditions during these two months come very near filling all the requirements of the perfect cotton culture. * * * During the months of June and July rains are not ordinarily heavy, and floods occur only at long intervals. * * * The largest number of rainy days that occur during the two months usually take place at stations along the Atlantic and Gulf coasts. At stations in the interior the rain is not so frequent, but with the exception of some of the stations in Texas there is never less than ten normal rainy days in each month, thus furnishing ample moisture for all the demands of the cotton plant while in its blooming season. Much rain during this period is decidedly injurious to the plant, because the flowers are so singularly constituted that if water accumulates in the cups formed by the petals and sepals rapid decay will take place, caused by fermentation of the gelatinous substance generated at the base of the flowers, and the forms will shed off and the yield of the plant be correspondingly decreased. * * *

Much cloudy weather during this period is almost as injurious as continual rains, for the reasons already stated—the cotton plant is a sun plant. Now a glance at our tables will show that the normal conditions throughout the cotton belt are very favorable for the growth of such a peculiarly delicate plant. If the season during April and May has been propitious, the tap root is deep in the soil at this stage of

the plant and the supply of moisture brought up from below is amply sufficient for all demands if a shower falls occasionally. * * *

This plant can stand a much longer drouth while blooming than almost any other vegetation, and hence the fall of rain should not be more frequent than once in three or four days, and the showers should be very light, permitting as much as possible the largest amount of sunshine. [Tables show] that the number of days on which rain is apt to fall during these two months does not exceed 51 per cent at any point in the entire region of the cotton belt, and at most places it generally does not exceed 40 per cent. The average number of sunny days during June and July is 56 per cent. At many of the stations, however, the percentage of perfectly clear days is greater than that given above for the entire region. * * *

These records show a very uniform condition of the temperature that is so suitable for the successful cultivation of the cotton during its flowering period.

Character of weather best suited for the production of fiber during its process of formation.—The first boll generally opens early in August, the interval from the first bloom to the first boll being about forty to fifty days, the shorter interval being required later in the season. The plant continues to bloom during the month of August and until the latter part of September, but its powers in this regard are steadily reduced, as the vitality goes more and more into growing the already formed bolls and bringing them to maturity. * * *

During this period of the history of the cotton plant there must be an abundance of sunshine and a small amount of moisture. * * * In September the probability of rain in the northern section of the cotton belt is as 1:4, or one day in four may produce rain. The normal rainfall for this month in the same region of the cotton belt is 3.03 inches, so that the eight days of precipitation may produce on an average 0.38 of an inch each day. This indicates a dry month in its normal condition, and therefore very favorable for gathering the staple. The large per cent of sunshine, 61 per cent, causes the bolls to open rapidly and preserves the fiber in its purest whiteness. The tables of rainfall and days of rain and cloudiness show that this character of weather continues through October, thus furnishing two months of fine season for gathering the crops. In the central portion of the belt we find a similar condition of the cast of the sky. The probability of rain in September is 27 per cent out of 100; and the per cent of cloudy days is 44, or 56 per cent of sunshiny weather. The normal rainfall for this section for September is 4.74 inches, or 0.59 of an inch for each of the 8 days of rain. There is more rain throughout the southern belt than in either of the other two. The normal is 5.72 inches, the probability of rain is 1:3, or 33 days in 100 may produce rain. The per cent of cloudy days is 44.8. So that during September there is a probability of 55 days of sunshiny weather in 100.

The picking season and its weather.—The months of autumn are spent in gathering the staple, and by the end of November, if the season is favorable, almost the entire crop will be picked. All that the cotton planters desire during this period of the year is that frost will be delayed as late as the last week in November and that after the middle of September heavy rainstorms will not occur, but that showers, if they come at all, shall be light and not frequent. * * * It is not often in the South that heavy rains occur in autumn, and monthly averages seldom go above 3.50 inches, but more frequently fall below 2 inches. The winds are also generally light, so that the cotton is not greatly damaged by being driven out on the ground and stained. * * *

According to charts very carefully made from the records of 100 stations over the Southern States, the normal time of frost for October 15 passes as far north as Kittyhawk, Charlotte, Chattanooga, Nashville, Cairo, Dodge City, and Fort Elliott, while the frost line for November passes through Charleston, Atlanta, Starksville, Vicksburg, and Palestine. We may safely assert, therefore, that usually there will be good picking season, as far as the temperature is concerned, until November 1.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Roots, potatoes, and fodder corn, T. SHAW AND C. A. ZAVITZ (*Ontario College Sta. Bul. No. 86, Feb. 1, 1893, pp. 8*).—Notes and tabulated data for tests of varieties of turnips, mangel-wurzels, carrots, sugar beets, potatoes, and corn. The largest yields were given by white-fleshed turnips, long mangel-wurzels, white carrots, and dent varieties of corn. The yields of corn fodder varied with distance of planting and size of the variety. Mammoth Southern (sweet) gave the best results when the plants were 42 by 12 inches apart; Wisconsin Earliest (white dent), 30 by 12 inches; Compton Early, 30 by 4 inches.—A. C. T.

Germination experiments, A. LYTTKENS (*Berättelse för År 1891 rörande Frökont rollanstalternas verksamhet, Stockholm, 1893, pp. 221–223*).—Investigations have been conducted at the seed control station at Nydala (Sweden) to study the effect of the soaking of seeds previous to the germination test. One lot of seed was soaked in distilled water for eight hours, and was then placed in the germination apparatus; another lot was put into the apparatus at the same time without any previous treatment. The following table shows the results:

Influence of previous soaking on the germination of seeds.

Number of days.	Red clover, 40 samples.				Alsike clover, 18 samples.				Timothy, 14 samples.			
	Per cent germinated.		Total per cent germinated.		Per cent germinated.		Total per cent germinated.		Per cent germinated.		Total per cent germinated.	
	Soaked.	Not soaked.	Soaked.	Not soaked.	Soaked.	Not soaked.	Soaked.	Not soaked.	Soaked.	Not soaked.	Soaked.	Not soaked.
1	32.63	8.23	32.63	8.23	7.90	2.85	7.90	2.85	......	......	......	......
2	44.72	50.58	77.35	58.81	45.55	41.65	53.45	44.50	......	......	......	......
3	8.20	23.24	85.55	82.05	12.55	19.50	66.00	64 00	......	......	......	......
4	2.29	4.87	87.84	86.92	5.65	8.50	71.65	72.50	44.70	34.10	44.70	34.10
5	0.62	1.32	88.46	88.24	2.95	2.25	74.60	74.75	22.50	23.55	67.20	57.65
6	0.27	0.51	88.73	88.75	2.15	2.20	76.75	76.95	12.15	14.90	79.35	72.55
7	0.25	0.30	88.98	89.05	1.85	1.50	78.60	78.45	3.95	6.05	83.30	78.60
8	0.16	0.26	89.14	89.31	0.80	0.80	79.40	79.25	2.20	3.60	85.50	82.20
9	0.14	0.26	89.28	89.57	0.85	0 40	80.25	79.65	1.80	2.25	87.30	84.45
10	0.12	0.53	89.70	90.10	2.40	2.50	82.65	82.15	1.30	2.05	88.60	86.50
Total	89.70	90.10	......	......	82.65	82.15	......	......	88.60	86.50	......	......
Hard	7.85	7.95	......	......	12.50	13.75	......	......	......	......	......	......
Not germinated	2.45	1.95	......	......	4.65	4.10	......	......	11.40	13.50	......	......
Total	100.00	100.00	......	......	100.00	100.00	......	......	100.00	100.00	......	......

With red clover 6 series of experiments gave the same result with and without soaking, 14 series higher results after soaking, and 20 series lower results after soaking; with alsike clover 4 series gave the same result with and without soaking, 7 series higher results after soaking, and 8 series lower results after soaking; and with timothy 2 series gave the same result with and without soaking, 8 series higher results after soaking, and 4 series lower results after soaking.

The author concludes that previous soaking has no definite influence on the final result of the germination test, at least as regards the clover seeds; the influence on the energy of the germination process, however, is plainly noticeable; the soaked seeds germinate largely during the first few days, so that not until the fifth or sixth day is the sum of the percentage of germination equal in both cases.

The Skara seed control station (director Dr. O. Nylander) studied the question of the influence of varying length of soaking on the germination process (*loc. cit.*, p. 223). A sample of fir seed was soaked nine hours and twenty-five hours, two trials being made in each case with 200 seeds.

Effect on germination of soaking fir seeds different lengths of time.

	Per cent germinated.		
	First trial.	Second trial.	Average.
After 9 hours' soaking	83.5	83.5	83.5
After 25 hours' soaking	83.0	86.5	84.5
After 39 hours' soaking*	89.0	87.5	88 3
After 120 hours' soaking*	77.5	60.0	68.3

* Not from the sample used in the first two experiments.

These experiments in connection with those of previous years confirm the opinion that forest seeds ought to be soaked for about twenty-four hours previous to the germination test, although special cases may occur where the length of the soaking period may be shortened or somewhat lengthened without any danger to the germinating power of the seeds.—F. W. WOLL.

Determination of crude fiber in feeding stuffs with the aid of the centrifuge, W. THÖRNER (*Chem. Ztg., 1893, pp. 394, 395*).—Substances containing much fat are freed from fat by treatment with ether in a tube fitting the centrifuge, and the ether extract is then separated by whirling the tube for a few minutes, pouring off the ether extract, and washing the residue with ether. The digestion with dilute acid and alkali is carried on in the same tube, heating each time in a boiling-water bath and stirring the contents of the tube with a glass rod. After each digestion the tube is whirled, the supernatant liquid poured off through a weighed filter, and the residue washed twice with water. Finally the residue is brought on the filter, washed with alcohol and

ether, dried, and weighed. The filter is burned and the loss on ignition, less the weight of the filter, taken as crude cellulose.

The author gives the results of a number of parallel determinations on rice meal, ground barley, and sunflower-seed cake, which agree within 0.2 per cent; but no comparative trials with other methods are given. It is claimed that the method is both accurate and rapid. Eight determinations can be made in three or four hours.—E. W. A.

An investigation of Swedish fodder plants, A. G. KELLGREN and L. F. NILSON (*Kgl. Landtbruks. Akad. Handlingar och Tidskrift, 32 (1893), pp. 1–32*).—An economic, botanical, and chemical study of a number of fodder plants, mostly from northern Sweden, from the provinces of Dalarne and Norrbotten.

Methods of analysis.—(1) Dry matter: The air-dry samples were cut into small pieces and dried for forty-eight hours in an air bath at 70° C.; they were then ground and sifted through a 1 mm. sieve, and left in the air for some time. About 3 grams of this material was heated at 100° C. in a current of CO_2 until the weight was constant.

(2) Ether extract: 5 grams of air-dry material dried for three hours at a temperature below 95° C., was transferred to a Soxhlet extractor and extracted with alcohol and water-free ether for six hours; after completed extraction the ether was distilled off, the flasks dried for one half hour at 100° C., placed in a desiccator to cool, and weighed.

(3) Nitrogenous substances: Determined by the Kjeldahl method. The separation of the group into amides, digestible and indigestible protein, was made according to Stutzer's methods.

(4) Crude fiber: The Weende method was followed. Three grams of substance was used and the results were corrected for ash and nitrogen in the residue.

(5) Mineral matter: The residue from the determination of dry matter was ignited on thin platinum disks (1 by 5 by 7 cm.) in a muffle oven at a low heat.

The chemical composition of the grasses and sedges studied is given in the following table:

Composition of Swedish forage plants.

Name.	Moisture.	Ash.	Crude cellulose.	Crude fat.	Crude protein.	Nitrogen-free extract.
GRASSES.						
1. Redtop (*Agrostis vulgaris*, With.):	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Air-dry	8.07	4.73	26.51	1.49	9.81	49.39
Dry		5.14	28.84	1.62	10.67	53.73
2. Wood-hair grass (*Aira flexuosa*, L.):						
Air-dry	7.66	4.25	29.86	2.58	7.81	47.84
Dry		4.60	32.34	2.79	8.46	51.81
3. *Baldingera* [*Phalaris*] *arundinacea*, L.:						
Air-dry	7.56	9.64	29.23	1.60	9.39	42.58
Dry		10.43	31.62	1.73	10.16	46.06
4 Blue-joint grass (*Calamagrostis stricta*, Trin.):						
Air-dry	7.14	3.31	34.70	1.42	5.57	47.66
Dry		3.56	37.37	1.53	6.21	51.33
5. Spear grass (*Glyceria spectabilis*, M. and K.). Cut in July:						
Air-dry	7.34	8.30	31.06	1.59	9.06	42.65
Dry		8.96	33.51	1.72	9.78	46.03
6. Spear grass (*Glyceria spectabilis*, M. and K.). Cut in September:						
Air-dry	7.86	7.28	26.15	2.16	11.50	45.05
Dry		7.90	28.38	2.34	12.48	48.90
7. Mountain meadow grass (*Poa alpina*, L.):						
Air-dry	9.11	3.76	25.64	2.40	6.19	52.90
Dry		4.14	28.21	2.64	6.81	58.20
8. June grass (*Poa pratensis*, L.):						
Air-dry	7.76	7.11	31.69	2.10	7.37	43.97
Dry		7.71	34.36	2.28	7.99	47.66
Average for dry matter in 1–8		6.55	31.83	2.08	9.07	50.47
SEDGES AND RUSHES.						
9. Bog sedge (*Carex acuta*, L.). Cut July 29 at Dalarne.						
Air-dry	8.71	3.03	26.81	2.34	11.50	47.61
Dry		3.32	29.37	2.56	12.60	52.15
10. Bog sedge (*Carex acuta*, L.). Cut July 20 at Norrbotten:						
Air-dry	8.04	4.98	26.87	2.33	7.50	50.28
Dry		5.41	29.22	2.53	8.16	54.68
11. *Carex ampullacea*, Good:						
Air-dry	6.96	4.08	26.16	2.15	7.19	53.46
Dry		4.38	28.11	2.31	7.73	57.47
12. Smaller bog sedge (*Carex cæspitosa*, L.):						
Air-dry	8.08	3.67	26.50	2.05	12.50	47.20
Dry		3.99	28.83	2.23	13.60	51.35
13. Slender-leaved sedge (*Carex filiformis*, L.):						
Air-dry	6.93	4.53	28.54	2.29	9.12	48.59
Dry		4.87	30.66	2.46	9.80	52.21
14. *Carex irrigua*, Sm.:						
Air-dry	7.01	4.09	27.24	2.92	10.87	47.87
Dry		4.40	29.29	3.14	11.69	51.48
15. Scaly club rush (*Scirpus cæspitosus*, L.):						
Air-dry	7.21	2.35	23.68	2.02	9.94	54.80
Dry		2.53	25.52	2.18	10.71	59.06
16. Slender rush (*Juncus filiformis*, L.):						
Air-dry	8.44	5.28	24.58	1.87	12.56	47.27
Dry		5.77	26.85	2.04	13.72	51.62
Average for dry matter in 9–16		4.33	28.48	2.43	11.00	53.75

Amount and digestibility of nitrogen in Swedish forage plants.

Name.	Nitrogen. Total.	Nitrogen. Amide.	Nitrogen. Digestible.	Nitrogen. Per cent digestible.
GRASSES.				
	Per cent.	*Per cent.*	*Per cent.*	
1. Redtop (*Agrostis vulgaris*, With.):				
Air-dry	1.57	0.34	1.03	65.5
Dry	1.71	0.37	1.12	....
2. Wood-hair grass (*Aira flexuosa*, L.):				
Air-dry	1.25	0.32	0.94	75.2
Dry	1.35	0.35	1.02	....
3. *Baldingera* [*Phalaris*] *arundinacea*, L:				
Air-dry	1.50	0.41	1.09	72.7
Dry	1.62	0.45	1.18	....
4. Blue-joint grass (*Calamagrostis stricta*, Trin.):				
Air-dry	0.92	0.20	0.69	75.0
Dry	1.00	0.22	0.75	....
5. Spear grass (*Glyceria spectabilis*, M. and K.). Cut in July:				
Air-dry	1.45	0.28	1.18	81.4
Dry	1.56	0.30	1.27	....
6. Spear grass (*Glyceria spectabilis*, M. and K.) Cut in September:				
Air-dry	1.84	0.29	1.44	78.3
Dry	2.00	0.31	1.56	....
7. Mountain meadow grass (*Poa alpina*, L.):				
Air-dry	0.99	0.26	0.76	76.9
Dry	1.09	0.29	0.83	....
8. June grass (*Poa pratensis*, L.):				
Air-dry	1.18	0.32	0.93	78.8
Dry	1.28	0.35	1.01	....
Average for dry matter in 1–8	1.45	0.33	1.09	75.5*
SEDGES AND RUSHES.				
9. Bog sedge (*Carex acuta*, L.). Cut July 29 at Dalarne:				
Air-dry	1.84	0.23	1.16	63.0
Dry	2.01	0.25	1.27	....
10. Bog sedge (*Carex acuta*, L.). Cut July 20, at Norrbotten:				
Air-dry	1.20	0.20	0.65	54.2
Dry	1.30	0.22	0.71	....
11. *Carex ampullacea*, Good.:				
Air-dry	1.15	0.14	0.61	53.0
Dry	1.23	0.15	0.66	....
12. Smaller bog sedge (*Carex cæspitosa*, L.).				
Air-dry	2.00	0.10	1.05	52.5
Dry	2.18	0.11	1.14	....
13. Slender-leaved sedge (*Carex filiformis*, L.):				
Air-dry	1.46	0.16	0.78	53.4
Dry	1.56	0.17	0.83	....
14. *Carex irrigua*, Sm.:				
Air-dry	1.74	0.14	0.98	56.3
Dry	1.86	0.15	1.05	....
15. Scaly club rush (*Scirpus cæspitosus*, L.):				
Air-dry	1.59	0.16	0.89	56.0
Dry	1.71	0.17	0.96	....
16. Slender rush (*Juncus filiformis*, L.):				
Air-dry	2.01	0.62	1.32	65.7
Dry	2.19	0.68	1.44	....
Average for dry matter in 9–16	1.75	0.24	1.00	5.68†

* Equals 6.8 per cent digestible protein in dry matter.
† Equals 6.3 per cent digestible protein in dry matter.

The analyses are accompanied by information as to the distribution and manner of growth of the various plants, their economic value, adaptability to more extended culture, etc. We give below a résumé of the paper:

Grasses.—1. Redtop (*Agrostis vulgaris*, With.): This is one of the most frequent grasses in the valleys and also in the fields of northern Dalarne; it seldom grows higher than 25 inches; it is leafy and with a

slender stem; it is well adapted to pastures and highly prized for that purpose. Jordan, Bartlett, and Merrill found the digestion coefficient for crude protein to be 60.4 per cent (artificial digestion coefficient 65.5 per cent, see above).

2. Wood-hair grass (*Aira flexuosa*, L.): This grass is abundant even in the driest and poorest places; hence is one of the best field grasses for northern Sweden. It grows best in clearings after pine forests, but is also found near and above the forest line. Its growth is variable; in open places the root leaves are short and juicy, forming a dense rosette; in forests they grow long and slender, and are fewer in number. The latter form is best adapted to pasture for cattle, the former for horses and sheep. It seems to be unable to stand barn-yard manure. In northern Sweden *Aira flexuosa* has the reputation of favorably influencing and even increasing the fat content of milk.

3. *Baldingera* [*Phalaris*] *arundinacea*, L.: This is one of our largest grasses. It is leafy, well liked as a forage crop for cattle, grows far north, and may be cut several times. It grows only on well-drained ground, in northern Dalarne, preferably along shallow lake shores with stony bottom. In culture experiments conducted for a long series of years from 1837 and on, at the experimental grounds of the Swedish Agricultural College, this grass grown on a stiff clay soil, in 1840 produced a yield of 16 tons of hay per hectare (7 tons per acre) in three cuttings; only half of this yield was secured on moist ground.

4. Blue-joint grass (*Calamagrostis stricta*, Trin.) grows in all moist fields. The stems and leaves of this grass are somewhat hard; hence it makes an inferior hay. It will grow even in marshes. It grows 15 to 30 inches high, blossoms in July, and has ripe seed in a month. Chemical analysis would indicate inferior value as a fodder.

5, 6. Spear grass (*Glyceria spectabilis*, M. and K.) will grow very tall even to 80 inches high. It has been mentioned of late as a promising fodder plant. It will grow farther south than the above-mentiond grasses. Three crops may be secured during the year. Analyses given in the table are averages of two samples taken in the beginning of July while blossoming, and in the middle of September before blossoming. It will be noticed from the analyses that the fall sample contains more protein and ether extract and less crude fiber than the July sample.

7. Mountain meadow grass (*Poa alpina*, L.) resembles *Poa pratensis*, but is shorter, with stems 10 to 20 inches long and shorter root leaves. It is well liked as a pasture grass; also well adapted to hay-making. In the Swiss Alps regions this grass, as well as *Meum mutellina* and *Plantago montana*, are prized most highly as pasture grasses. *Poa alpina* is low in protein, but also in crude fiber; high in nitrogen-free extract and in percentage of digestible protein substances.

8. June grass (*Poa pratensis*, L.) is common on sloping, well-manured ground in Dalarne, and is always most luxuriant during the year when

manure is applied. It is well adapted to pasturing. The stem is 25 to 30 inches high, and the herbage is fine and makes a soft, palatable hay. Meadow hay from Dalarne contains 10 to 15 per cent of this grass, and is saved for horses, while cattle and sheep receive meadow hay of inferior quality, and sedges. This grass blossoms in Dalarne in the beginning of July, and the seed is ripe the middle of August. It is very persistent on manured ground.

According to the chemical composition the above grasses are to be ranked in the following order: *Glyceria*, *Baldingera* [*Phalaris*] *arundinacea* and *Agrostis vulgaris*, *Aira flexuosa*, which may be considered about as valuable as the two species of *Poa*, and *Calamagrostis stricta*.

Sedges and rushes.—These are generally considered of inferior value as forage plants. It is, however, likely that this opinion ought to be modified; in northern Dalarne whole regions are found where all pastures are made up wholly of these grasses, and the dairy products made there are nevertheless in every way first-class products.

9–14. *Carex acuta*, L., *C. ampullacea*, Good., *C. cæspitosa*, L., *C. filiformis*, L., and *C. irrigua*, Sm., are all used as hay for cattle; *C. ampullacea* and *C. filiformis* are eaten with avidity by pasturing cows. In Dalarne the former is considered the most valuable as a forage plant of the five sedges mentioned. The low protein content of the sample analyzed does not coincide with this opinion, but it is possible that the lateness of the season when the sample was taken (beginning of August) accounts for the discrepancy found. *Carex acuta* is also a valuable fodder; it is large and roughish. *C. filiformis* grows large, but the leaves are few and very slender; *C. cæspitosa* and *C. irrigua* are smaller varieties.

15, 16. *Scirpus cæspitosus*, L., as well as *Juncus filiformis*, L., are both doubtless of less feeding value than the true grasses, but they nevertheless fill a place among the forage plants of mountain regions. *Scirpus* may be considered equal to the best varieties of sedges; it is developed early in the spring, which is decidedly in its favor. It grows to a height of only 10 to 12 inches, while *Juncus* is often 5 feet high.

Considering the average chemical composition of the true grasses and of the sedges and rushes, as given in the preceding table, it is very striking that the percentages of the valuable constituents, protein, fat, and nitrogen-free extract, are higher, on an average, in the latter, more despised plants, and the crude fiber content of these is lower than that of the true grasses. The digestion coefficients for the protein compounds in the two groups indicate that the true grasses are more digestible, and, calculated on the quantity of digestible protein in the dry matter, these are found to contain 6.8 against 6.3 per cent digestible protein in the sedges and rushes. This difference is not large, however, and the inferior feeding value of the sedges and rushes must be explained in some other way; the more roughish, sharp leaves and

stems, which make them somewhat less palatable to cattle, may partly explain the problem. It is certain, however, that they produce a soft and aromatic hay, which is well liked by cattle and horses. Being grown far north, with an abundance of pure water rich in valuable mineral constitutents, they have a finer, more delicate foliage, and are thus more palatable to animals than the same varieties grown farther south would be.

The sedges and rushes are never allowed to form ripe seeds when cut for hay in the fields of the northern mountain regions, and there is thus no chance for loss of seeds and the valuable protein compounds contained in them.—F. W. WOLL.

Importance of asparagin as a food nutrient, S. GABRIEL (*Zeitsch. Biol., 29 (1892) pp. 115–125*).—The author reports numerous experiments with rats, from which the inference is drawn that asparagin may be of value as food, but first becomes of importance when the albuminoid supply of the food is deficient. He refers to observations in connection with Weiske's experiments on asparagin. Weiske found that asparagin, like albuminoids, hindered the depression in digestibility of the carbohydrates liable to occur when they are fed in large quantities. The author likewise noticed that the feces of animals fed on nitrogen-free food gave a distinct reaction for starch, showing that this substance was being imperfectly digested, while in the case of animals receiving asparagin the feces were free or nearly free from undigested starch. This leads to the suggestion that action of asparagin is perhaps only an indirect action, favoring the thorough digestion of the carbohydrates of the food.—E. W. A.

Advantages of allowing cows to drink at will, BACKHAUS (*Schles. Landw., abs. in Molk. Ztg., 1893, No. 4, p. 40*).—The trial described was made to test the advantages of having watering troughs in the stalls, allowing the cows to drink at will.

A herd of Dutch cows was kept for a time in ordinary stables, and water brought to them twice daily; they were then changed to stalls having troughs in each manger with constant water supply; and afterwards they were changed back again to the ordinary stables and watered twice. The milk yield increased, on an average, 0.53 liter per cow daily, and there was no decrease in fat content. The increased yield is calculated to be about 100 liters per cow annually. Unfortunately the abstract does not state the duration of the periods. The cows drank a little less when allowed to drink at will than when watered twice a day. The author mentions several advantages from a hygienic standpoint.—E. W. A.

Composition of milk and milk products, H. D. RICHMOND (*Analyst, Mar., 1893, pp. 50–58*).—This is a report for the year 1892 of the work done in the laboratory of the Aylesbury Dairy Company. During the year 25,931 samples were analyzed, all but a few of which were of milk and dairy products. The results are summarized and bring out

some interesting points. Analyses of 13,196 samples of milk as received for delivery to customers showed the average composition for the year to be: Total solids, 12.71; fat, 3.91, and solids-not-fat, 8.80 per cent; specific gravity, 1.0320.

"During the first three months of the year the quality of the milk was fully up to the average, but in the latter months a depression, especially in solids-not-fat, was noticed. This causes the yearly average to be the lowest yet observed, lower than last year.

"As usual the highest percentages of total solids and fat are to be found in November, while, as is frequently the case, the lowest occur in June."

One case in which the solids-not-fat were especially low was found to be due to an abnormally low milk sugar content.

Butter had the following composition:

Composition of butter.

	French butter, fresh.		French butter, salted.		English butter, salted.	
	Range.	Average.	Range.	Average.	Range.	Average.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Water	13.29-14.93	13.98	11.29-14.32	12.86	11.58-16.49	13.99
Fat	83.12-85.49	84.39	81.93-85.35	83.44	80.14-86.19	82.98
Solids-not-fat	1.09- 2.22	1.63	2.73- 4.29	3.70	1.78- 4.98	3.03
Salt (in solids-not-fat)	0.07- 0.18	0.12	1.26- 3.08	2.07	1.16- 3.93	2.14
Volatile fatty acids*	25.4-30.8	29.10	26.2-32.8	29.10	24.9-30.8	28.10

* Reichert-Wollny figures.

A butter made from the milk mentioned above as abnormally low in solids-not-fat gave the lowest Reichert-Wollny figures—24.9.

Analyses of the ice and liquid portions of frozen milk gave the following results:

Analyses of frozen milk.

	Ice.	Liquid portion.
	Per cent.	*Per cent.*
Water	96.23	85.62
Tar	1.23	4.73
Sugar	1.42	4.95
Proteids	0.91	3.90
Ash	0.21	0.80
Specific gravity	1.009	1.0345

"The quantity of ice amounted to about 10 per cent in this case. The proportions that the various [solid] constituents bear to each other is not markedly different in the ice and the portion which is unfrozen, showing that no great separation, if any at all, has taken place during freezing." In delivering frozen milk to customers, the proper course to follow was to strain off the ice and throw it away. Thawing the ice and mixing the two liquids did not give a uniformly normal milk, as the solids would continue to separate out.

A series of about 2,930 analyses were made to study the tendency of cream to rise on the milk during delivery. The general conclusion was that this tendency was overcome by the constant agitation in transit, provided the milk was not allowed to stand long enough at any time during delivery for the creaming to commence. If this took place the shaking was not sufficient to hinder the creaming, and it continued in spite of the motion. "In rounds which were out for six hours no rising of cream could be detected, provided that no long intervals of time were permitted in which the milk remained at rest."

Comparisons between the Adams and the Werner-Schmid methods for fat showed "practically absolute agreement." In the Werner-Schmid method, as used by the author, 5 c. c. of milk, 5 c. c. of water, and about 11 c. c. of strong hydrochloric acid are heated in a tube to boiling, over a naked flame, until the fat forms a clear layer on the top, the tube being constantly shaken during boiling. The tube is cooled, 25 c. c. of ether added, and the whole well shaken. After the separation of the two layers, which "is practically instantaneous," the ether is pipetted off, a further quantity added, and the treatment repeated three times. The ether is evaporated and the fat weighed.

Single determinations can be made more rapidly by the Werner-Schmid method than by the Adams method; but the former is held by the author to be less convenient where a number of samples are to be tested, and scarcely as reliable as the Adams method.

A series of comparisons of the Reichert-Wollny and the Leffmann-Beam methods of determining volatile fatty acids "shows that the glycerol saponification (Leffmann-Beam method) gives slightly higher results than the alcohol saponification, and this has been confirmed by direct experiment. The use of glycerol has several distinct advantages, among which may be enumerated sharper end reaction, clear distillate, absence of possibility of loss of ethers during saponification, and saving of time."

In the discussion following the reading of the report it was urged that 15 per cent of water was the maximum quantity allowable in market butter, though butter direct from the dairy would often contain more water. Mr. Richmond thought his results showed that 15 per cent was a sufficiently high amount to allow.—E. W. A.

Comparative trials of the Babcock milk test, R. HEINRICH, (*Molk. Ztg., 1893, No. 4, pp. 37, 38*).—A very favorable report on a series of trials of the Babcock milk test, made at the Rostock experiment station. The test was compared with the gravimetric method and with the lactocrite on numerous samples of normal milk, extra rich milk, cream, and skim milk. The centrifuge used for whirling the bottles was a more solidly built apparatus than is commonly sold with the machine in this country, and allowed of a velocity of 1,500 revolutions per minute. A speed indicator was used. On 27 samples of normal milk comparisons were made of whirling the bottles at rates of 800 and 1,500 revo-

lutions per minute. The agreement of the results with the gravimetric results was closer at a speed of 1,500 revolutions than at 800. Run at 1,500 revolutions, the largest difference from the results of gravimetric analysis was 0.1 per cent less. In nearly one half of the cases results by the two methods were identical, or only differed by 0.02, and the average difference on the 27 samples was 0.03 per cent (3.66 by gravimetric and 3.63 by Babcock test).

At a speed of 800 revolutions the results ran from 0.11 to 0.39 per cent too low, averaging 3.44 as compared with 3.66 by gravimetric analysis.

Whirling the bottles for a longer time gave no better results. In other words, continued treatment could not make up for the lower rate of speed.

The showing for the lactocrite was slightly inferior to the Babcock test when run at 1,500 revolutions, but superior when run at 800. The results averaged 3.60 per cent (gravimetric 3.66).

The results of the Babcock test, run at 1,500 revolutions, on richer milk, cream, and skim milk were entirely satisfactory, the agreement being within 0.07 per cent of the gravimetric results.

The author concludes that in the modified form (run at 1,500 revolutions) the Babcock test is an exceedingly simple method, fully equal in accuracy to any in use for determining the fat content of milk. Among its advantages over other tests he mentions the following:

(1) The operation of the Babcock apparatus is simpler and easier. The heating of the milk required by the lactocrite test is avoided and the measurement is more direct and simple. As compared with the Soxhlet apparatus, the glass parts are much less liable to get broken.

(2) The fat layer in the tube can be kept for a considerable time for reference if the cases are contested. It is only necessary in such cases to place the tube in warm water and then whirl again in the centrifuge.

(3) The milk samples may be measured out into the bottles and left for weeks before testing without affecting the accuracy of the result. The samples can therefore be kept until a number accumulate and then all tested at one time.

(4) The test is cheaper. At the prices paid in Rostock, the original acid mixture for the lactocrite cost 1.39 pfennigs per test, or the new acid mixture over 5 pfennigs. The ether for the Soxhlet test cost 4.1 pfennigs, while the acid for the Babcock test cost only 0.35 pfennigs per test (about one-twelfth of a cent).

(5) The cost of the apparatus is also low in comparison with the lactocrite and Soxhlet apparatus.—E. W. A.

A new method for the determination of fat in milk, L. LIEBERMANN and S. SZÉKELY (*Zeitsch. analyt. Chem.*, *32*, *pp. 168–173*).—The authors believe the methods in which common ether is used as the solvent to be lacking in accuracy, owing to the fact that this solvent dissolves other substances than milk fat. Attention has previously been

called to the matter by one of the authors and by others. When every precaution was used it was found impossible to redissolve with sulphuric ether all the extract after drying. This was true when the Adams method or drying on sand and gypsum was followed. There was invariably an insoluble residue. With petroleum ether, on the other hand, there was no such residue, and the percentage of fat found was slightly lower than with the sulphuric ether. They report a series of comparisons of the two ethers, showing differences in results ranging from 0.03 to 0.48 and averaging 0.17 per cent of fat, the sulphuric ether always giving the higher result. The differences are so large that it is believed impossible to explain them on the ground that the excess was due to impurities in the paper, sand, or gypsum which the alcoholic ether dissolved. It is urged that the excess must have come from a solution of something other than fat in the milk. They mention further that the ether extract was usually yellowish, while the petroleum-ether extract was pure white.

In view of these facts they recommend the use of petroleum ether. They also recommend a new method which is a modification of one already published by Liebermann (*Zeitsch. analyt. Chem., 22, p. 383, and 23, p. 476.*)

The method is as follows: 50 c. c. of milk is shaken in a tall cylinder with 5. c. c. of potassium hydrate, of 1.27 specific gravity; and then with 50 c. c. of petroleum ether, of about 0.663 specific gravity, which boils at 60° C., and which leaves no residue on evaporation. The emulsion formed is shaken with 50 c. c. of about 96 per cent alcohol, and after standing 4 or 5 minutes the ether layer rises. It is shaken three or four times, allowing the ether layer to rise each time. This suffices to dissolve all of the fat, as experiment has shown. Twenty cubic centimeters of the ether-fat layer is pipetted into a small tared flask, the ether evaporated on a water bath, and the residue dried at 110°–120° and weighed.

Comparisons are reported on 11 samples of the new method and the Adams method or drying on sand, using petroleum ether in all cases in place of common ether, the differences between the results ranging from 0 to 0.08, and averaging 0.049 per cent of fat.

It is suggested that an error arises in calculating the amount of milk taken from its volume and specific gravity; and that this might be reduced by taking smaller quantities of milk.

The advantages claimed for the method are accuracy, rapidity, and the possibility of repeating the determination from the same ether-fat solution.—E. W. A.

Report of work done at Swedish experiment stations during 1891 (*Verksamheten vid de kemiska stationerna för jordbruket och näringerna under år 1891, Stockholm, 1893*).—The report shows the activity of the Swedish experiment stations along the different lines taken up for study. The great bulk of the work relates to the control of agri-

cultural products and foods. The seven Swedish stations are located at Skara, Halmstad, Kalmar, Vesterås, Oerebro, Hernösand, and Jönköping. Of these the two first mentioned and the Vesterås and Oerebro stations are of greatest importance.

The total number of samples submitted for analysis during 1891 at all the stations was as follows: Soil, 375; soil amendments, 60; fertilizers, 749; feeding stuffs, 425; water, 214; dairy products, 13,619; food products, 234; for detection of poisons (wall paper, clothes, yarn, etc.), 2,724; technical products, 201; sundries, 119; total, 18,720.

Materials used for bedding.—An examination of the absorptive power and composition of various materials used for bedding and as absorbents in stables, made at Jönköping station, gave the following results:

Composition and absorptive power of bedding materials.

Material.	Hygroscopic moisture.	Ash.	Nitrogen.	Multiple of its own weight of water absorbed by water-free sample.
	Per cent.	*Per cent.*	*Per cent.*	
Aspen shavings	8.84	0.70	0.06	3.1
Pine shavings	8.15	0.32	0.007	4.0
Birch shavings	9.68	0.37	0.08	5.3
Oak shavings	12.43	0.51	0.06	3.9
Heath litter	7.93	2.31	0.74	3.2
Wheat straw	8.82	3.96	0.64	3.9
Rye straw	7.63	3.39	0.44	4.9
Barley straw	8.60	5.43	0.32	4.3
Oat straw	8.34	8.31	0.65	4.1
Birch leaves	11.34	4.15	1.14	4.5
Oak leaves	11.04	6.30	1.10	3.7
Peat	11.14	0.41	0.42	16.9
Moor earth	18.35	1.12	0.60	15.1

Fat content of Swedish herd milk.—The numerous analyses of milk made at the different stations during the year form a very good basis for judging the quality of Swedish herd milk. The determinations of fat were made partly by Soxhlet's areometric method, partly by the lactocrite.

At Skara, 700 samples of new milk were examined by Soxhlet's method, with the following results:

Number of samples.	Per cent of samples.	Per cent of fat.
3	0.4	1.0–2.0
29	4.2	2.0–2.5
146	20.9	2.5–3.0
308	44.0	3.0–3.5
165	23.5	3.5–4.0
45	6.4	4.0–5.0
4	0.6	over 5.0
700	100.0	

The number of samples of new milk analyzed at the Halmstad, Ves-

terås, and Oerebro stations are given in the following table, with the average percentage of fat contained in them. The samples are arranged according to months.

Fat content of Swedish herd milk, 1891.

Month.	Halmstad. Number of samples.	Halmstad. Per cent of fat.	Vesterås. Number of samples.	Vesterås. Per cent of fat	Oerebro. Number of samples.	Oerebro. Per cent of fat.	Total number of samples.	Average per cent of fat.
January	73	3.25	820	3.22	64	3.15	957	3.22
February	261	3.11	946	3.27	99	3.12	1,306	3.27
March	401	3.19	1,017	3.26	24	3.21	1,442	3.24
April	354	2.99	988	3.23	72	3.28	1,414	3.17
May	126	3.29	668	3.26	123	3.10	917	3.24
June	202	3.10	692	3.38	88	3.07	982	3.29
July	114	3.30	788	3.40	22	3.13	924	3.38
August	129	3.02	622	3.54	98	3.40	849	3.44
September	137	3.06	747	3.56	51	3.37	935	3.48
October	151	3.30	691	3.48	16	3.40	858	3.45
November	56	3.13	588	3.46	21	3.31	665	3.43
December	141	3.09	711	3.42	35	3.31	887	3.36
Sums and averages	2,145	3.11	9,278	3.37	713	3.24	12,136	3.33

The average per cent of fat for the year, 3.33 per cent, is the mean of the monthly averages; if all analyses made are averaged, the mean will be 3.31 per cent, as the average of more than 12,000 analyses made at three different stations during 1891.

Analyses of skim milk and buttermilk gave the following results: At Vesterås, separatór skim milk (104 samples), average 0.28 per cent fat; highest 0.84 per cent, lowest 0.09 per cent. Skim milk from ice system (60 samples) average 0.69 per cent fat; highest 1.18 per cent, lowest 0.26 per cent.

At Oerebro, skim milk (12 samples), highest 0.19 per cent fat, lowest 0.16 per cent fat. Average per cent fat in buttermilk 0.47, in whey 0.34.—F. W. WOLL.

Agricultural statistics of Denmark, 1891–'92 (*Tidsskr. f. Landöko-nomi, 12 (1893) pp. 1–40, 176–201*).—A review of the condition of Danish agriculture during 1892. The following table gives a summary showing the excess of the exports over imports during the year ending September 30, 1892, and also the value of the products. A minus sign means that more was imported than exported.

Excess of Danish exports over imports of agricultural products.

	Quantity. 1891–'92.	Quantity. Average for preceding 10 years.	Value. 1891–'92.	Value. Average for preceding 10 years.
Cereals ...bushels	—6,740,345.85	—5,308,898.59	$—5,118,800	$—3,698,400
Rape and linseed ...do	—759,810.10	—616,855.00	—911.200	—723,600
Oil cakes ...million pounds	—134.04	—98.10	—1,822,400	—1,340,000
Bran ...do	—190.37	—169.42	—2,090,400	—1,768,800
Fertilizers ...do	—77.38	—42.33	—562,800	—321,600
Wool ...do	—0.44	—0.66	—80,400	—134,000
—	....	....	10,586,000	7,986,400

Excess of Danish exports over imports of agricultural products—Continued.

	Quantity.		Value.	
	1891-'92.	Average for preceding 10 years.	1891-'92.	Average for preceding 10 years.
Mill products ....bushels..	238,460.37	1,345,898.50	$321,600	$1,768,800
Horses .... number..	5,390	8,143	881,400	1,527,600
Oxen and cows ....do....	3,558	88,471	4,475,600	4,609,600
Calves.........................do....	1,543	7,323	13,400	80,400
Sheep ....do....	17,872	55,270	107,200	348,400
Hogs ....do....	193,731	184,454	4,120,000	4,430,400
Meat ....million pounds..	2.31	0.07	134,000	536
Pork ....do....	78.70	39.02	8,127,600	3,618,000
Butter........................ do....	76.17	43.98	18,518,800	9,993,200
Eggs.................million dozen..	12.00	7.09	1,902,800	1,072,000
	....	....	38,605,400	27,478,936
Value of excess of exports.....	....	....	28,019,400	19,492,536

Ten and nine tenths million bushels of cereals were imported, and 4.2 million bushels exported; of the quantity imported 5.7 million bushels consisted of corn (maize), 5.2 million bushels of which came from the United States. The greatest increase in exports, minus imports, comes on pork and butter. Denmark now supplies more pork to the United Kingdom than any country, except the United States, and more than all other European countries put together. The income from this article increased 33 per cent during 1892 above what it was during the preceding year.

The exportation of butter decreased a little during 1892, but as the price received was higher than during 1891, the value of the product amounted to about $250,000 more in 1892 than in 1891. The exports and imports of pork, butter, and eggs during 1892, 1891, and the average for 1881-'91 are shown in the following statement:

Danish exports and imports of pork, butter, and eggs.

	Exports.			Imports.			Excess of exports over imports.		
	1892.	1891.	1881-'91.	1892.	1891.	1881-'91.	1892.	1891.	1881-'91.
Pork..million pounds..	86.92	67.87	44.11	8.58	5.83	5.18	78.54	62.04	38.94
Butter.......do........	100.21*	101.53†	56.54	24.20	23.98	12.65	76.01	77.55	45.16
Eggs....million dozen..	13.50	12.30	7.70	1.50	1.80	0.70	12.00	10.50	7.00

* 97.68 million pounds went to England. † 98.34 million pounds went to England.

F. W. WOLL.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

The Stock process for the determination of nitrogen—a modified distillation process, W. F. K. STOCK.—*Analyst, March, 1893, p. 58, fig. 1.*

The Stock method for the rapid determination of nitrogen in organic bodies—a reply to W. P. Skertchly, W. F. K. STOCK.—*Analyst, March, 1893, pp. 58–63.*

A review of recent investigations on the determination of nitrogen in organic matter, W. FRESENIUS and P. DOBRINER.—*Zeitsch. analyt. Chem., 32, Heft 2, pp. 235–242.*

On the estimation of nitrogen in saltpeter, nitrate of soda, and nitric acid (*Beitrag zur Bestimmung des Stickstoffs in Kali-Natron-Salpeter und in Salpetersäure*), J. STOKLASA.—*Zeitsch. angew. Chem., 1893, Heft 6, pp. 161–163.*

Determination of nitrogen, saltpeter, and saltpeter mixtures by reducing the nitric acid to ammonia (*Bestimmung des Stickstoffs in Salpeter und Salpetergemischen durch Reduction der Salpetersäure*), T. F. SCHMIDT.—*Chem. Ztg., 1893, No. 11, p. 173.*

Recognition of ammonia with Nessler's reagent (*Zum Nachweis des Ammoniaks mit Nessler'schem Reagens*), L. L. DE KONINCK.—*Zeitsch. analyt. Chem., 32, Heft 2, p. 188.*

The determination of potash (*Zur Bestimmung des Kaliums*), E. W. HILGARD.—*Zeitsch. analyt. Chem., 32, Heft 2, pp. 184–185.*

An accurate and rapid method of determining crude fiber in feeding stuffs with the aid of the centrifuge (*Genaue und schnelle Bestimmung der Holzfaser in Futtermitteln mit Hülfe der Centrifuge*), W. THÖRNER.—*Chem. Ztg., 1893, No. 23, pp. 394, 395.*

On the analysis of liquid fats (*Beiträge zur Analyse der flüssigen Fette*), W. FAHRION.—*Chem. Ztg., 1893, No. 25, pp. 434–436.*

A new method of determining the iodine number of fats and oils (*Eine neue Methode zur Bestimmung der Jodzahl in Fetten und Oelen*), F. GAUTTER.—*Zeitsch. analyt. Chem., 32, Heft 2, pp. 181–184.*

Effect of pilocarpine and phloridzin on the formation of sugar in milk (*Influence de la pilocarpin et de la phloridzin sur la production du sucre dans le lait*), CORNEVIN.—*Compt. rend., 116 (1893), p. 263; abs. in Chem. Ztg., 1893, Repert., p. 55.*

The nomenclature of milk albuminoids, H. D. RICHMOND.—*Chem. News, 67 (1893), p. 132.*

Brullé's reagent for detecting oleomargarine in butter (*Ueber das Brullé'sche Reagens, um Oleomargarin in der Butter zu erkennen*), G. MARIANI.—*Abs. in Chem. Ztg., 1893, Repert., p. 55.*

A modification of the Reichert-Meissl method of butter analysis (*Eine Modification der Reichert-Meissl'schen Methode der Butterprüfung auf Margarin*), J. PINETTE.—*Chem. Ztg., 1893, No. 23, pp. 395, 396.*

Note on the theory and practice of the Reichert process, H. D. RICHMOND.—*Analyst, March, 1893, pp. 64, 65.*

The dialysis of honey (*Ueber die Dialyse des Honigs*), M. MANSFELD.—*Zeitsch. Nahr.-Untersuch. u. Hyg., 7 (1893), p. 83; abs. in Chem. Ztg., 1893, Repert., p. 67.*

The reserve proteid of the asparagus root, J. H. VINES and J. R. GREEN.—*Proc. Roy. Soc. London, 52 (1892), pp. 130–132.*

Rapid method of reducing potassio-platinic chloride (*Rasche Reduction des Kaliumplatinchlorids*), H. BORNTRÄGER.—*Zeitsch. analyt. Chem., 32, Heft 2, p. 188.*

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Forms and colors of Saccharum officinarum (*Formen und Farben von Saccharum officinarum*), F. SOLTWEDEL and F. BENECKE.—*Mitt. Vers.-Sta. Zuckerrohr, Semarang, Java, pp. 29, plates 21; abs. in Bot. Centralbl., 54, No. 1, p. 28.*

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On lard (*Ueber Schweinefett*), E. SPAETH.—*Zeitsch. angew. Chem., 1893, Heft 5, pp. 133–136.*

The value of cooking and steaming food and of warming water for milch cows (*Die Fütterung unseres Milchviehes mit gekochtem oder gedämpftem Futter und die Verabreichung angewärmter Tränke*).—*Molk Ztg., 1893, No. 2, pp. 14, 15.*

Feeding experiments with rye bran for cows (*Fütterungs-Versuch mit Roggenkleie*), VON LIEBENBERG.—*Mitt. Ver. Förd. landw. Versuchswesens, Heft 7, part 2, pp. 148–153.*

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The composition of butter, with special reference to the percentage of water allowable (*Die Zusammensetzung der Butter, insbesondere hinsichtlich des zulässigen Wassergehalts*), DU ROI.—*Molk Ztg., 1893, No. 8, pp. 93, 94.*

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On ptomaines in cheese (*Ueber Ptomaïne im Käse*), V. MALENCHINI.—*Zeitsch. Nahr.-Untersuch. u. Hyg., 7, p. 7; abs. in Chem. Centralbl., 1893, I, No. 8, p. 397.*

The sampling of milk (*Die Milchproben Entnahme*), R. BACKHAUS.—*Molk. Ztg., 1893, No. 5, pp. 49–51.*

A method of determining fat in milk (*Un procédé de dosage du beurre dans le lait*), A. RUFFIN and L. SEGAND.—*L'Ind. Lait., 18 (1893), No. 3, pp. 19, 20.*

Determination of the fat content of milk (*Zur Bestimmung des Fettgehalts in der Milch*), WEISS.—*Pharm. Ztg., 38, p. 87; abs. in Chem. Centralbl., 1893, I, No. 12, p. 589.*

Detection of goat's milk in cow's milk (*Nachweis der Ziegenmilch in der Kuhmilch*), SCHAFFER.—*Schweiz. Wochensch. Chem. u. Pharm., 31 (1893), p. 58; abs. in Chem. Ztg., 1893, Repert., p. 67.*

Effect of centrifugal treatment on the distribution of bacteria in milk (*Ueber die Wirkung des Zentrifugierens und die Verteilung der Bakterien in der Milch*), NIEDERSTADT.—*Zeitsch. Nahr.-Untersuch. u. Hyg., 7, p. 3; abs. in Chem. Centralbl., 1893, I, No. 8, p. 396.*

On bitter milk, and the sterilization of milk by heating under exclusion of air (*Ueber bittere Milch und die Sterilisierung der Milch durch Erhitzung unter Luftabschluss*), M. BLEISCH.—*Zeitsch. Hyg., 13, pp. 81–99; abs. in Chem. Centralbl., 1893, No. 9, p. 434.*

The sterilization of milk (*Zur Milchsterilisierung*), K. FLAACH.—*Milch Ztg., 1893, No. 8, pp. 119–122, and No. 9, pp. 140–143.*

The sterilization of milk on a large scale (*Ueber Milchsterilisierung im Grossbetrieb*), HESSE.—*Zeitsch. Hyg., 13, pp. 42–48; abs. in Chem. Centralbl., 1893, I, No. 8, p. 397.*

How can the souring of milk be postponed, and what is the best temperature for creaming milk centrifugally? (*Wodurch kann man die Milch länger frisch erhalten,*

und welche Temperatur ist bei der Centrifugirung der Milch als die günstigste anzusehen?), HITTCHER.—*Königsberger land- u. forstw. Ztg., also Fühling's landw. Ztg., 1893, Heft 5, pp. 164–168.*

On the raising of cream on the milk route, and experiments with appliances for preventing it (*Zum Aufrahmen der Milch in Verkaufswagen und Versuche mit Rahmverteilern*), A. BERGMANN.—*Milch Ztg., 1893, No. 1, pp. 4, 5; abs. in Chem. Centralbl., 1893, 1, No. 9, p. 435.*

The spread of contagious diseases by milk and dairy products (*Die Verschleppung ansteckender Krankheiten durch die Milch and Milcherzeugnisse, und die Erzeugung von Krankheiten durch Milchgenuss*), MEHRDORF, WEIGMANN, NEUHAUSS, SCHUPPAN, *et al.*—*Molk.-Ztg., 1893, No. 8, pp. 94–96.*

Separation of butter from buttermilk by the centrifuge (*Rendement en beurre de lait traité par l'écrémage centrifuge suivi de barattage*), CHEVRON.—*L'Ind. Lait., 18 (1893), No. 10, pp. 75–77.*

Organization and work of coöperative creameries in Denmark (*Organisation et fonctionnement des laiteries coopératives au Danemark*), E. LOUÏSE.—*Bul. Min. Agr., Paris, 12 (1893), No. 1, pp. 46–64.*

On the causes of abnormal ripening of cheese (*Ueber die Ursachen und die Erreger der abnormalen Reifungsvorgänge beim Käse*), L. ADAMETZ.—*Milch Ztg., 1893, No. 12, pp. 187–190.*

Influence of temperature on the water content of soft cheeses (*Recherches relatives á l'influence de la température sur la quantité d'eau renfermée dans les fromages à pâté molle*), E. MER.—*L'Ind. Lait., 18 (1893), No. 11, pp. 83–86.*

Agricultural instruction in France (*Das landwirtschaftliche Unterrichtswesen in Frankreich*), K. RUMKER.—*Landw. Jahrb., 22 (1893), Heft 1 and 2, pp. 105–228, figs. 6.*

EXPERIMENT STATION NOTES.

MASSACHUSETTS COLLEGE.—The annual report for 1892 shows that the attendance of students during that year was the largest in the history of the college. Of the 192 students present during the year, 16 were from without the State, and the remaining 174 represented 110 towns. The appendix to the report contains a large number of useful "facts for farmers," and a list of good books on a variety of subjects, such as agriculture, agricultural chemistry, crops, dairying, entomology, feeding, fertilizers, forestry, fruits, live stock, political science, etc.

OKLAHOMA STATION.—The board of regents, as at present organized, includes C. O. Blake, El Reno, president; J. E. Quein, Edmund, secretary; A. A. Ewing, Kingfisher, treasurer; J. C. Fletcher, Chandler; A. J. Seay, governor of Oklahoma, *ex-officio*. F. A. Waugh, P. S., has been appointed horticulturist.

ROAD-MAKING.—The Ontario Department of Agriculture has issued a special bulletin on the making of roads, by J. A. Bell, in which the methods of construction of different kinds of roads are described, and suggestions made regarding the repair, maintenance, and improvement of country roads.

UNIVERSITY EXTENSION WORK IN AGRICULTURE.—A prospectus of the Agricultural Department of the University College of North Wales outlines the system of outside work carried on under the supervision of the college. The work is classified as follows: (1) Dairy instruction; (2) classes for the instruction of schoolmasters in agriculture, chemistry, botany, etc.; (3) local classes in agriculture; (4) extension lectures; (5) field experiments.

Three dairy schools have been established in different places in connection with the college, and the college also possesses a fully equipped traveling dairy, which is carried from place to place in accordance with arrangements made with local committees.

The course of instruction for schoolmasters is arranged as follows: First year—Agriculture, 16 lectures and 2 field demonstrations; chemistry, 8 lectures; botany, 8 lectures. Second year—Agriculture, 16 lectures and 2 field demonstrations; agricultural chemistry, 8 lectures; zoölogy and physiology, 8 lectures. The lectures are as a rule delivered on alternate Saturdays throughout the session. At the end of the course a certificate is granted to candidates who have passed an examination.

"With the view of furthering the promotion of permanent centers of agricultural education throughout the country districts, the Agricultural Department is prepared, in the manner described below, to render assistance to committees formed for the purpose of promoting the establishment of classes in agriculture:

(1) To assist, by means of introductory lectures and otherwise, in the formation of evening classes in agriculture. Such lectures will be delivered free wherever the local committees guarantee the traveling expenses of the lecturer and make the necessary local arrangements.

(2) To grant permission to teachers recommended by the committee to attend the college course of agriculture for teachers at its nearest center.

(3) To contribute, as far as the funds at its disposal will admit, towards the traveling expenses of schoolmasters attending such courses.

(4) To lend wall diagrams, tables, books, illustrative sets of specimens of rocks, soils, manures, plants, seeds, etc. * * *

(5) To conduct examinations for any local exhibition which may be offered for the purpose of enabling students of evening classes to proceed to the college. * * *

(6. To furnish plans and instructions for the management of small experimental plats for purposes of demonstration."

The college is prepared during the next session to offer short courses of lectures in the principal agricultural centers of North Wales, on the following subjects: Drainage and improvement of land; laying down and management of pasture; live stock of the farm; dairying and its successful conditions; the cultivation of vegetables; management and rotation of crops; insects injurious to crops; domestic animal pests (sheep rot, warble, etc.); the chemistry of soils and manures (artificial and natural); foods and feeding stuffs; diseases of field crops; and the plants of the farm.

Since the establishment of the agricultural department of the college, field experiments have been carried out in many parts of North Wales, and at the present time experiments are in progress on the manuring of oats, pasture land, hay, and root crops.

Fertilizers for turnips and pastures.—The Agricultural Department of the University College of North Wales has published reports on experiments with fertilizers on pasture lands and on Swedish turnips at a number of places in North Wales. In general, the results show good returns from the use of basic slag. The quality of the slag was found to be very important.

Traveling Dairies.—The annual report of the Queensland Department of Agriculture for the year 1891-'92 contains an account of the work done by traveling dairies in Queensland during the year. These dairies are operated under the direction of the Department and spend ten days in each place visited, giving instruction in improved methods of butter and cheese-making. It is stated that while the expense of working the dairies is small, they have had an important influence in improving the quality of the butter and cheese made in the colony.

Fertilizer Inspection in Georgia.—Bulletin No. 23 of the Department of Agriculture of Georgia, by G. F. Payne, State chemist, contains notes on valuation and methods of inspection; legislation relating to fertilizers in Georgia; an essay on the history, nature. and uses of commercial fertilizes; analyses, with comments, of a fruit preservative, lime, and limestone; tabulated results of examinations of over 1,200 samples of materials, including commercial fertilizers, kainit, muriate of potash, sulphate of potash, nitrate of soda, cotton-seed meal, minerals, mineral water, marls, clay, and natural phosphates; formulas for fertilizer mixtures for different crops; and tabulated data on the growth of the fertilizer trade in Georgia since 1874.

India.—The report on crop experiments in the Bombay Presidency, 1891-'92, gives an account of 83 field experiments in different localities with rice, wheat, sugar cane, cotton, and a variety of native crops.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

MARCH, 1893.

BUREAU OF ANIMAL INDUSTRY:

Bulletin No. 1.—Report on Investigations into the Nature, Causation, and Prevention of Texas or Southern Cattle Fever.

DIVISION OF BOTANY:

Farmer's Bulletin No. 10.—The Russian Thistle and other Troublesome Weeds in the Wheat Region of Minnesota and North and South Dakota.

DIVISION OF CHEMISTRY;

Bulletin No. 36.—Experiments with Sugar Beets in 1892.

DIVISION OF STATISTICS:

Report No. 102 (new series), March, 1893.—Agriculture in Alaska; Foreign Official Crop Estimates; European Crop Report; Wheat Crop of the World; Freight Rates of Transportation Companies.

Report on Distribution and Consumption of Corn and Wheat, March, 1893.

Report No. 5 (miscellaneous series).—Production and Distribution of the Principal Agricultural Products of the World.

WEATHER BUREAU:

Monthly Weather Review, December, 1892.

Supplement to Monthly Weather Review for December—Annual Summary for 1892.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

MARCH, 1893.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 42, January, 1893.—Coöperative Soil Test Experiments.

ARKANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 21, December, 1892.—Grapes; Some Insects and Fungous Diseases and their Remedies; Spraying Apparatus; Apples and Grapes in Arkansas.

Bulletin No. 22, December, 1892.—Sorghum and Cane Sugar Culture; Sirup and Sugar Making on Small Farms; Some Field Experiments with Canteloupes and Corn.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Bulletin No. 100, February 12, 1893.—Investigation of the Cattle Foods of California.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 115, March, 1893.—Common Fungous Diseases and their Treatment; Preparation of Fungicides.

DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 19, December, 1892.—Can Peach Rot be Controlled by Spraying? A Preliminary Report.

GEORGIA EXPERIMENT STATION:

Bulletin No. 20, February, 1893.—Fertilizer, Culture, and Variety Experiments; Corn and Cotton.

Fifth Annual Report, 1892.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF IDAHO:

Bulletin No. 2, December, 1892.—Announcement and Proposed Work of the Stations.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:

Bulletin No. 22, August, 1892.—Experiments with Wheat, 1891-'92.

Bulletin No. 23, November, 1892.—Experiments with Oats, 1892.

Fifth Annual Report, 1891-'92.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 20 (2d ser.), January, 1893.—Tobacco Growing in Louisiana, with Results of Experiments at Calhoun, Louisiana.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 13, June, 1891.—Strawberries.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 50, February, 1893.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 23, February, 1893.—Varieties of Cotton.

Bulletin No. 24, February, 1893.—Fertilizers for Cotton.

Technical Bulletin No. 1, December, 1892.—A Chemical Study of the Cotton Plant.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Bulletin No. 26, March, 1893.—Meteorological Observations for 1892.

Bulletin No. 27, March, 1893.—Experiments in the Culture of Sugar Beets in Nebraska.

Sixth Annual Report, 1892.

NEVADA AGRICULTURAL EXPERIMENT STATION:

Fifth Annual Report, 1892.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 92, February, 1893.—Feeding Experiments with Horses; Dried Brewers' Grain *vs.* Oats.

AGRICULTURAL EXPERIMENT STATION OF NEW MEXICO:

Bulletin No. 8, November, 1892.—Wheat, Oats, Barley, Rye, Sugar Beets, Sorghum, and Cañaigre—Varieties Tested, Manner of Planting, Irrigating and Cultivating; Results Obtained.

Bulletin No. 9, December, 1892.—Insecticides and their Appliances.

Third Annual Report, 1891-'92.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 49, December, 1892.—Sundry Investigations of the Year.

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Third Annual Report, 1892.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 45, December, 1892.—Insects Affecting the Blackberry and Raspberry.

Bulletin No. 48, February, 1893.—Profit in Spraying Orchards and Vineyards.

OKLAHOMA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 4, October, 1892.—Tests of Varieties—Oats, Corn, Spring Wheat, Irish, and Sweet Potatoes.

OREGON EXPERIMENT STATION:

Bulletin No. 23, February, 1893.—Experiments in the Culture of the Sugar Beet in Oregon.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 21, January, 1893.—Sea-Weeds—Their Agricultural Value; The Chemical Composition of Certain Species.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Fifth Annual Report, 1892.

AGRICULTURAL EXPERIMENT STATION OF UTAH:

Third Annual Report, 1892.

VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE EXPERIMENT STATION:

Bulletin No. 22, November, 1892.—Bush Fruits.

WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 26, September, 1892.—Law and Regulations Concerning the Sale of Commercial Fertilizers in the State of West Virginia; Analyses.

Bulletin No. 27, November, 1892.—Notes on Pruning.

Bulletin No. 28, December, 1892.—Plat Experiments with Commercial Fertilizers on Corn.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:

Bulletin No. 34, January, 1893.—Preventive Treatment for Apple Scab, Downy Mildew and Brown Rot of Grape, Potato Blight, and the Smut of Wheat and Oats.

WYOMING AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 11, February, 1893.—Crop Report for 1892.

Bulletin No. 12, April, 1893.—Ground Squirrels (Gophers).

EXPERIMENT STATION RECORD.

VOL. IV. MAY, 1893. NO. 10.

The feasibility and desirability of home-mixing of fertilizers have been clearly demonstrated by the stations. The published results of investigations by stations engaged in the examination of fertilizers leave no doubt regarding the fact that "from such raw materials as are in our markets, without the aid of milling machinery, mixtures can be and are annually made on the farm, which are uniform in quality, fine, and dry, and equal in all respects to the best ready-made fertilizers."

The advantages to be derived from home-mixing are so obvious that it is hardly necessary to do more than enumerate them:

(1) *Reduction in expense.*—This is strikingly brought out in a recent bulletin of the New Jersey Station. Home-mixed fertilizers representing a purchase of 540 tons gave an average cost per ton of $31.36 at the point of consumption. The average cost per ton of eight special brands selected as the most highly concentrated of 212 brands examined was $43.50, "or a difference of $12.14 per ton in favor of the home mixtures, which contained at least $2 worth of plant food in excess of that in the manufactured brand."

(2) *A definite knowledge of the nature of the plant food employed.*—Each ingredient can be separately examined by the purchaser, inferior materials can be readily detected, and those best adapted to special needs selected.

(3) *The preparation of mixtures suited to special needs of soil or crop.*—"It is self-evident that an intelligent farmer by home-mixing is better able than anyone else can be to adapt the composition of his fertilizers to the special requirements of his land as well as of his crop."

(4) *The indirect educational advantages.*—This is probably the strongest recommendation of the practice. It will encourage a spirit of inquiry among those using fertilizers, and will lead them to study and apply the results of agricultural research, thus contributing much toward the fixing of the practice of farming on a rational, scientific basis.

The time has come when the farmer should discard "a system which leads him to consider chiefly the rival claims of competing manufactur-

ers rather than his own needs," and should by some system of coöperation buy the unmixed materials for his fertilizers under their proper names in large quantities, and mix them as an intelligent consideration of the object desired seems to suggest.

With the vast amount of station literature sent broadcast through the country giving the latest and most reliable information on the best sources of supply of fertilizing materials, the most effective mixtures and combinations for different crops and soils, and the best methods of application, there is no reason why intelligent home-mixing of fertilizers should not be generally practiced to the marked advantage of the farming community.

Questions relating to the vitality and purity of seeds have already engaged the attention of a number of our stations. The objects and methods of such examinations of seeds as the stations make and the importance of systematic seed-testing are not fully appreciated in this country. The tests thus far made have on the whole made a favorable showing for the responsible growers and dealers in American seeds. This is especially true of the seeds of ordinary vegetables. But it has also been shown that in many instances the farmer is defrauded in the purchase of old or impure seeds. The business of seed growing and selling is greatly expanding with the growth of our farm population and the diversification of agriculture. There is increasing need that the stations should keep a watchful eye over the interests of the farmers in this direction, and that at least the leaders of progressive agriculture in this country should clearly understand what is implied in scientific seed-testing.

The system of seed investigation and control now in vogue in Europe was originated by Prof. F. Nobbe, of Tharand, Saxony. The methods which he worked out are used with more or less modification in the numerous seed-control stations in operation in Germany and other European countries. It was hoped that Prof. Nobbe would consent to prepare an article on seed investigation for the Record. When he found himself unable to undertake this work, Dr. Oscar Burchard, of the Botanical Laboratory and Seed-Control Station at Hamburg, was invited to write the article on this subject, a part of which is published in the present number of the Record. The plan for the article was arranged by consultation with Prof. Nobbe, who has kindly written the following as an introduction.

The investigation and control of seeds for agricultural use, which was developed in Germany, and has been in effective operation there and in other European countries for a number of years, is happily making headway in the United States. The treatise upon the subject by Dr. O. Burchard, of Hamburg, which I have read with interest, seems to me well fitted to explain the object, the working methods, and the most desirable ways of organizing seed-control stations, and hence to be of service for promoting international coöperation in the struggle against the extensive and disastrous evils which obtain in seed traffic.

THE OBJECT AND METHODS OF SEED INVESTIGATION AND THE ESTABLISHMENT OF SEED-CONTROL STATIONS.

Dr. Oscar Burchard.

Thanks to the advance in agriculture and the increasing effort to secure large grain and fodder crops, the production and consumption of seed have greatly increased. The commercial aspect of the seed industry has steadily kept pace with the demand, and, with the continued improvement and widening of commercial relations, seeds from many sources and of manifold variety and kind and differing widely in value are found in all our markets. Under the influence of competition, which affects agriculture as it does other industries, the farmer is forced to utilize every means to increase and improve his products. One of these means is the use of better seed. Experience shows that, next to securing correctly labeled varieties, the quality of the seed itself is of the most importance.

In the estimation of the value of seeds a number of different factors have to be considered. Many of these are not easily judged by the external appearance of the sample.

A sort of control of the value of the cereal grains has been exercised from time immemorial by use of the specific gravity, *i. e.*, the weight of a given volume, though this gives only a very imperfect idea of the quality. The large size of these seeds makes it comparatively easy to judge of their purity. To form even an approximately correct estimate of the value of smaller seeds from their weight and appearance is much more difficult, and with clover and grass seeds, which are so important for the growing of fodder, it is practically impossible.

In the year 1869, Prof. F. Nobbe, of Tharand, Saxony, made the remarkable observation that out of a number of samples of grass seed sent him for botanical examination only about 30 per cent of the species corresponded with what the labels called for. This circumstance led to the examination of a large number of specimens of seeds taken from the stock of different growers and dealers. It was found that the percentages of correctly named varieties of seeds fell far below what ought to be expected, and more than that, in most cases the foreign admixtures were of such a character as to greatly impair the chances of satisfactory development of the valuable portions of the seed. Thus, for example, seeds of meadow grasses contained a large proportion of seeds of various wild grasses, the plants from which would shade the desirable grasses and tend to prevent their normal germination and

growth. Clover seed contained dodder and other undesirable admixtures. In fact, it transpired that the whole seed business was in a really deplorable condition.

These observations of Prof. Nobbe led the German farmers to send samples of the seed which they purchased to the experiment station at Tharand for tests of the genuineness and purity as well as the germinating power. These three characters came to be recognized as the fundamental factors in the estimation of the quality of seed. The methods of seed examination which have since become current include tests of each of these separately. By uniting the results of these several tests, in each case, an estimate is made of what Nobbe has termed the intrinsic value (*Gebrauchswerth*) of a given specimen of seed, and their rational interpretation gives the value for practical use (*Nutzwerth*) of commercial seeds.

Thus was established at Tharand, in 1869, the first seed-testing station. This assumed such an importance that kindred institutions were speedily established in other places, until to-day there are forty-two of these stations in Germany alone, and many more in other countries. Their usefulness, which is becoming more and more manifest, is twofold.

It is evident, in the first place, that the estimation of the intrinsic value of seeds and the solution of numerous other questions regarding their quality offer to the practical farmer the best possible means for judging the value of the seeds he finds offered for sale. In the second place the statistical results of the seed tests as they have been made through a long series of years show a very marked improvement in the intrinsic value, and especially in the purity of the seeds in the market. This improvement has been brought about by the united effort of the specialist who examines the seeds and the farmers who make use of the results of the examinations. Furthermore, the dealers have reaped benefit from the system of seed investigation, since sellers of good wares are protected from the injurious competition of inferior goods. Experience has shown that through the introduction of the seed control, notwithstanding the higher prices that have been demanded for tested seed, the sales have been in no way diminished.

The examination of seeds, as has been stated, is not confined to tests of purity and germinating power. The seed-control stations push the botanical examinations of seeds in various directions. The advance of botanical knowledge of seeds makes it possible to test the purity of the less common kinds of seeds, and to distinguish between different varieties as well as species. It is becoming more and more practicable, not only to identify the foreign constituents, but also to tell to what extent and in what ways the latter are inferior or harmful. And it is essential that the botanist by whom the examinations are made should be familiar with botany in the widest sense, for it becomes his duty to give information as to the material itself, and also to advise as to the overcoming of difficulties of many kinds.

GERMAN METHODS OF SEED INVESTIGATION.

Having referred to the objects of seed investigation, we have now to consider the methods in vogue among the seed-control stations in Germany.

Sampling.—In examining a sample of seed, the first question is whether it is a fair one. Does it represent the composition and character of the whole lot in every particular? This matter is of very great importance and can not be insisted upon too strongly. An error in taking the sample will render the most skillful analysis worthless. The nonagreement of examinations of different samples of the same seed is due in most cases to bad sampling. In order to obtain a fair average sample from a lot of seed it must be taken, not from a single portion of the whole, but from many different portions. If the lot to be sampled is not too large, it can be poured upon a suitable cloth, *e. g.*, sacking, on a floor, thoroughly mixed with a shovel, and the surface made flat. Successive small portions are then taken from at least ten places, some at the surface, others at the bottom, and all combined in one sample. If the lot is too large to be handled in this way, small samples are taken directly from the individual sacks by means of a sampling tube. The instruments most used for this purpose in Germany are the well-known sampling tubes devised by Prof. Nobbe. These are of two kinds, the grain-sampler (*Kornprobenstecher*) and clover-seed sampler (*Kleeprobenstecher*).

FIG. 1. Grain-sampler.

For cereal and similar sized seeds the grain-sampler (Fig. 1), which is the larger of the two instruments, is employed. This is shaped like a cane, hollow, provided with a handle at one end and terminating in a point at the other. It consists of two tubes, one inside the other; both are perforated by a series of holes from one end to the other. The cylinders may be turned, one about the other, so as to open or close the holes. The point of the instrument is introduced into the top of the bag, and pressed downward to the bottom. The inner tube is then turned so as to open the holes. When it is filled with seed it is turned back so as to close the holes, and the contents thus serve as a sample from the whole length of the bag. The tube is 1.2 cm. in diameter, and 1 meter in length.

FIG. 2. Clover-seed sampler.

For drawing samples of small seeds, especially clovers, timothy, rape, etc., the clover-seed sampler (Fig. 2) is very much used. It has a length of 30 cm. and a diameter of 6 mm. About 2 cm. from the finely drawn-out point there is an oval opening 15 mm. long and 4 mm. broad through which the seeds may run sidewise into the tube when plunged into the bag. The lower part

of the tube will thus hold a small sample when the tube is withdrawn. If, for example, the sample is to be taken from several bags of seed, three small portions are drawn from each bag, one near the top, another in the middle, and the third near the bottom. These small portions are put together and make the whole sample.

Size of the sample.—Accurate results in the investigation of seeds depend not merely upon the manner of taking the sample, but also to some extent upon its amount. For instance, in determining the purity of seed, as will be shown beyond, it is often necessary to take special care in selecting the small portion which is used for analysis, and the range of error is largely dependent upon the size of the sample originally drawn. Furthermore, the determination of certain impurities, *e. g.*, the seeds of certain parasites or the size of the different species of seeds, often makes a comparatively large sample necessary. The experience in Germany has been such that upon the suggestion of Dr. Nobbe the Association of German Agricultural Experiment Stations has fixed upon the following for minimum quantities for samples of seeds of the species named: *Gramineæ, Trifolium, Lotus, Spergula, Lepidium, Pimpinella, Anethum, Fœniculum, Carum, Daucus, Petroselinum, Apium, Papaver, Nicotiana, Betula, Polygonum, Sorghum, Medicago, Ornithopus sativus, Onobrychis sativa, Vicia, Lens, Brassica, Camelina, Sinapis, Lactuca, Allium, Cichorium, Linum, Cannabis, Alnus, Carpinus,* and *Coniferæ*, 100 grams; and *Cerealia, Zea, Phaseolus, Pisum, Lupinus, Faba, Helianthus, Beta, Pomaceæ, Quercus,* and *Fagus*, 250 grams.

It occasionally happens that examinations of seed for disputed cases are to be made. For this purpose the average sample is divided into two or more portions, of which one or more are to be retained under seal. The same is done where the examinations are for use in court. For estimation of specific gravity 1½ liters are taken, since the impurities must be removed before the determination is made, and at least 1 liter of pure seed is needed for the latter.

In packing the sample for shipment great care is needed to insure against loss or injury. Wrappers may break so that part of the sample will escape and not enough remain for the needed tests, or the seed may be wet and dried and its germinating power impaired thereby. Stout, tight boxes are preferable. If these can not be obtained several layers of thick paper should be used.

When the sample is received at the station it is entered upon the registry book and its net weight noted. Thereupon preparations for analysis are made. The first of these is the making of the "smaller average sample," which serves for estimating the purity and from which, in consequence, all foreign seeds and extraneous matter are to be removed.

Quantitive estimation of purity.—In the quantitive determination of the percentage of foreign matters it is essential that the "smaller aver-

age sample" should accurately represent the original sample. For preparing it the so-called pouring method has come to be regarded as the best. In this the original sample is poured slowly from a wide-mouthed flask into a shallow vessel or upon a large, clean sheet of glazed paper. During the pouring portions of the seed are taken regularly with a small spoon. These portions, being from all parts of the original, together make a fair sample of it.*

A certain minimum quantity is requisite for the small sample. How large it shall be depends upon the kind and size of the seed to be investigated. The minimum quantities used in Germany for different kinds of seed are as follows: *Poa*, *Agrostis*, *Alopecurus*, *Aira*, and *Trisetum*, 2 grams; *Trifolium repens*, *T. hybridum*, *Holcus*, *Spergula*, *Anthoxanthum*, *Anethum*, *Carum*, and *Fœniculum*, 5 grams; *Trifolium pratense*, *T. incarnatum*, *Medicago sativa*, *M. lupulina*, *Anthyllis*, *Phleum*, *Lolium*, *Festuca pratensis*, *Dactylis*, *Cynosurus*, and *Daucus*, 10 grams; *Ornithopus*, *Acer*, *Ulmus*, and *Ornus*, 20 grams; *Onobrychis*, *Sorghum*, and *Brassica*, 25 grams; *Cerealia*, *Lens*, *Polygonum*, *Vicia*, *Linum*, *Picea*, *Pinus*, *Larix*, and *Carpinus*, 30 grams; and *Beta*, *Pisum*, *Phaseolus*, *Faba*, *Zea*, *Lupinus*, *Quercus*, and *Fagus*, 50 grams.

The examination is carried out as follows: The small sample which has been prepared as just described and has been weighed accurately to the milligram, is designated as (*a*) and put on a half sheet of glazed paper in a pile at the right. Successive portions are then brought to the middle of the sheet by a horn spatula and spread out so that the individual seeds can be easily distinguished. The foreign materials, which are classed as "foreign mixture," are sorted out and put in a small pile (*b*) beside (*a*), while all the genuine seeds, *i. e.*, those which are really of the kind claimed, are put in a pile (*c*) at the left. This operation is repeated, the greatest pains being taken to avoid loss of any of the material. A small loss in weight by evaporation of moisture and escape of dust is unavoidable, but it is neglected when it does not exceed 1 or 2 per cent of the whole, as it may be assumed to fall proportionately on (*b*) and (*c*).

The materials which are classified as foreign mixtures (*b*) may be divided into three classes: (1) All seeds of other species or varieties than that to which the lot of seeds under examination properly belongs. These include not only weed seeds, but also those of valuable cultivated plants, even if the latter are sold at the same or higher market price than the kind to which the sample is claimed to belong. (2) Genuine seeds, *i. e.*, those which are of the kind claimed, but which are evidently incapable of germinating, grains with the embryo injured or which are otherwise defective. (3) Dead matter, organic or inorganic, including, for instance, bits of stalk, straw, dust, sand, pebbles, etc.

* Good results can also be obtained by pouring the whole sample over the bottom of a flat vessel, shaking it slightly so as to spread it evenly, and then taking small portions from different parts both at the surface and below.

When the separation thus described is complete the two portions (*b*) and (*c*) are weighed separately and their sum (plus the unavoidable but slight loss above referred to) is equal to (*a*). The ratio of (*c*) to (*a*), expressed in per cent, is recorded as the proportion of impurities.

In the investigation of seeds with hard, smooth surfaces like those of cereals and legumes the separation of all of the foreign admixtures together is easy, and in general, the distinguishing between the several classes is unnecessary, except when some particular ingredient is present in especially large quantity. It is to be noted, however, that the separation of very fine particles of extraneous matter as well as of very small weed seeds is materially facilitated by the use of small round sieves* with apertures of different sizes or other apparatus described below.

Some kinds of grass seed are apt to contain materials which demand more systematic separation, especially when a specification of the nature of the foreign admixture, or of the amount of genuine but defective seed is desired. In such cases the inferior ingredients are first put by themselves and then the several constituents, as foreign or defective seeds, are separated.

Separation of defective grass seed.—In the examination of some of the larger kinds of grass seed, such as *Lolium*, *Avena elatior*, *Dactylis*, etc., the defective and sterile seeds are detected by the feel with a horn spatula. With some of the more delicate kinds, as *Alopecurus*, *Holcus*, and *Poa*, this process is very laborious and is hardly reliable. Sometimes it is impracticable because the presence or absence of the caryopsis can not be distinguished by the spatula. Other objects, as dried anthers and larvæ of insects, may give rise to error. To get around this difficulty the genuine seeds, freed from other kinds of seed, sand, etc.—in other words, the average sample as prepared for tests of germinating power—are soaked in water and then spread upon a glass plate over a light-colored surface. In this way it is easy to distinguish the seeds which have the caryopsis. It is hardly necessary to add that after the defective seeds are separated they should be dried and weighed in the air-dry condition. The purpose may be attained, though not quite as well, by putting the dry seed, *i. e.*, without previous soaking, upon a glass plate upon which sunlight is reflected by a mirror from below.

The separation of the seed envelopes from some kinds of grass seeds, as *Dactylis*, *Festuca ovina*, etc., is rendered difficult by their occurrence in more or less complex clusters which contain perfect and defective seeds together. In this case it is necessary to first free the seeds and then separate them mechanically.

* The sets of sieves devised by Nobbe for this purpose consist of sieves with apertures of 2, 1.5, 1.25, 1.0, 0.5, and 0.25 mm. diameter. The sets are to be had in three sizes, in which the sieves themselves are 20, 12, or 8 cm. in diameter.

Specification of ingredients of foreign admixture.—As already stated, it is often desirable to indicate not only the amount but also the kinds of impurities. Of the three classes above named, the first is the most important.

(1) *Species or varieties different from the one for which the wares are sold.*—Under this head may be mentioned first the complete or partial replacement of the genuine seeds by others of inferior value. It is not at all uncommon that the genuine seeds are mixed with others of similar size and color. Thus, red clover may be adulterated with yellow clover, which is much inferior; Swedish (alsike) clover with yellow hop clover (*Trifolium agrarium*), or turnip and rape (*Brassica napus* and *B. rapa*) with charlock (*Sinapis arvensis*). The valuable grasses are especially apt to suffer by admixtures of worthless kinds, the seeds of which are so similar in external appearance as to easily escape detection. When such impurities occur in any considerable amounts the percentage should be determined and stated in the report.

(2) *Non-noxious weeds.*—Weed seeds demand particular attention because they are very apt to occur among the seeds of cultivated plants and in widely varying proportions. They are very objectionable because of the injury they cause to the growth of the plants which are to be cultivated. Plants which are otherwise harmless, when once introduced, spread in various ways, infest the fields, and crowd out the valuable plants. The manifold ways in which many such seeds of *Compositæ*, *Asperifoliaceæ*, *Plantagineæ*, etc., are spread make them grievous enemies of the farmer.* Every effort should be used to keep them out of seeds which are to be sown.

Noxious plants.—It is still more important to avoid seeds of plants that contain ingredients which are poisonous to man or beast. Thus the seeds of *Lolium temulentum* and sometimes those of corn cockle, as well as some of the smaller vetches, are recognized as poisonous, so that when mixed with cereal grains and ground they make the flour objectionable. Their small size and light weight makes it comparatively easy to remove them by sifting or blowing.

It is, if possible, even more essential to keep seed of forage plants free from noxious admixtures. The damage done by *Euphorbiaceæ*, *Ranunculaceæ*, *Chenopodiaceæ*, and many *Cruciferæ* and *Umbelliferæ* will serve for illustration.

Plants which aid in the propagation of fungi.—Certain plants are prejudicial because they serve as hosts for injurious fungi or other

* Among the genera and species which are particularly objectionable are: Fleabane (*Erigeron*), bur marigold (*Bidens*), mayweed (*Anthemis cotula*), field camomile (*A. arvensis*), daisy, or whiteweed (*Chrysanthemum leucanthemum*), corn marigold (*C. segetum*), common tansy (*Tanacetum vulgare*), groundsel (*Senecio*), bluebottle (*Centaurea cyanus*), nipplewort (*Lanpsana communis*), chicory (*Cichorium intybus*), fall dandelion (*Leontodon autumnalis*), hawkweed (*Hieracium*), dandelion (*Taraxacum officinale*), sow thistle (*Sonchus*), common thistle (*Cirsium lanceolatum*), Canada thistle (*C. arvense*), wild lettuce (*Lactuca scariola*), etc.

parasites while these are passing through stages of development which prepare them for working injury to crops.

Sundry species—such as those of *Claviceps*, *Ustilago*, and *Puccinia*—are parasitic upon certain grasses, as *Lolium perenne*, *Triticum repens*, *Molinia*, and others, the seeds of which, like those of other wild and wood grasses, are to be avoided in the cereals. Other forms of *Claviceps*, *e. g.*, ergot, are to be watched for in the cereal grains. For example, eight samples of American fiorin grass (white bent grass, *Agrostis alba*) of the harvest of 1892 were found on examination to contain ergot in considerable amount. The numbers of sclerotia found to occur in one kilogram of the grass seed were in four samples sold as choice, 5,256, 11,856, 21,964, and 33,374; and in four samples sold as "fancy," 11,648, 39,300, 69,657, and 70,064, respectively. When these are spread in the ground, fruit is borne and spores produced which infest other plants.

Phænogamous parasites.—Even more to be feared are the seeds of certain phænogamous parasitic plants, which may cause the devastation of the fields where they grow. The worst of these are the dodders (*Cuscuta*). These, having no chlorophyll, prey upon the aërial parts of useful cultivated plants, and diminish the yield or ruin the crop entirely. In tests of purity of seed of fodder plants, therefore, dodder should be looked out for very sharply, and when found the proportion should be exactly determined. The seeds of the more common species of *Cuscuta* are characterized by small size, nearly spherical form, grayish to light-brown color, and the peculiar rough appearance of the testa. In European seed, *Cuscuta epithymum*, L., *C. trifolii*, Bab., *C. epilinum*, Weihe, and *C. europæa*, L., are common. *Cuscuta lupuliformis*, Krock, the kernels of which are larger than those of ordinary clover, averaging about 5.3 mg. in weight, is less frequent. The seeds of *C. epithymum* pass readily through a sieve with holes 1.25 mm. in diameter, which makes it comparatively easy to separate them from red clover.

In general the kinds of seeds in which it is particularly important to look for dodder are the different species of *Trifolium*, *Medicago sativa*, *M. media*, *M. lupulina*, *Phleum pratense*, *Linum usitatissimum*, and *Ornithopus sativus*. The most frequent dodders in American clover seed are *Cuscuta racemosa*, Mart., the seeds of which do not always pass a 1.25 mm. sieve, and *C. gronovii*, Wild, and *C. cephalanthi*, which are less common. In South American clover and lucern seed *Cuscuta arvensis*, Beyr. and *C. chiliensis*, Ker., have been found. The last named appears to occur both in Chile and in the Argentine Republic.

The examination of seed for dodder is conducted as follows: With small-sized clover seeds, as alsike and white clover, and timothy, the whole sample must be examined. Red clover, lucern, and yellow clover are sifted in very small portions and for a long time in sieves with cover and under cup (Nobbe's set of clover sieves). The contents of the several sieves of the set are then carefully examined, the coarser

portions, which remain on the sieves, carefully looked over and the dodder seed picked out. When all of the latter have been removed they are counted, and the number of seeds per kilogram in the sample estimated. The examination should be made, not of a part, but of the whole sample in every case, and in no case should the amount examined be less than 100 grams.

Among the other phænogamous parasites are the *Orobanchaceæ*, which live on the underground parts and occasionally on the lower part of the stem of the host. Their seeds are, in general, extremely small, those of *Orobanche minor* having, according to Nobbe, a diameter of only 0.25—0.40 mm. In South Germany *O. ramosa*, which lives upon hemp and lucern, is a much dreaded parasite. The seeds of these are separated by sifting like those of dodder.

The quantity of genuine seeds which have been so injured as to be incapable of germinating and of the fragments, *e. g.*, of embryo and radicle, depends upon the way the seed has been handled, especially in the threshing. The seeds and fragments thus damaged are, of course, to be distinguished from those which were harvested before they were ripe, or have been injured by wetting and drying, and are more or less shriveled. To determine the value or lack of value of such kernels, germination tests are necessary. If the amount of damaged seed is very large, it should be estimated.

Dead matter.—The quantity of fragments of stalk, straw, or chaff, and especially that of sand, stones, etc., varies widely, and is noticeable when it makes several per cent of the whole. The weight of mineral substances is a temptation to use them to adulterate seeds. Such frauds are easily detected. No rules can be laid down for the purpose, however. The size, form, and color of the small stones must be noted in each case. That such admixtures do occur is proven by the fact that there are establishments which manufacture yellow, green, and black stones for mixing with clover seed.

(To be continued.)

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY.

E. W. ALLEN, *Editor.*

The determination of sugar in the tomato, G. C. CALDWELL (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 301, 302*).—It is explained that neither the polariscope nor the Fehling test is wholly reliable for the direct determination of sugar in tomatoes, the first on account of the possible action of organic acids, and the second on account of other reducing substances besides sugar. The fermentation method proved unsatisfactory. In the method employed the fruit was dried at 100° C., and the ground residue extracted either with boiling water or with 90 per cent alcohol in a continuous extracting apparatus. The aqueous extract proved so highly colored that a volumetric determination with Fehling solution could not be made. Extraction with 90 per cent alcohol and determination of the sugar by the gravimetric copper method proved very satisfactory, duplicate results on the same extracts agreeing closely. The results of determinations in 13 samples are tabulated. The acidity was determined by means of a standard solution of potassium hydroxide, and calculated as malic acid.

ZOÖLOGY.

Ground squirrels, F. J. NISWANDER (*Wyoming Sta. Bul. No. 12, Apr., 1893, pp. 25–36, figs. 3*).—A ground squirrel or gopher, which is destructive to crops in Wyoming, is described. This species, thought by the author to be *Spermophilus franklinii*, is undoubtedly *S. elegans*, as it is not likely that the former species occurs in Wyoming.

This gopher digs up newly planted corn and garden seed, injures alfalfa and sugar beets, and greatly damages all small grain, eating the green plants and the grain as it ripens. On the station farm the barley was so injured as to yield only the quantity of grain which had been sown. These ground squirrels are destructive from about the middle of March until September, during which time they store up grain and seeds for winter use.

A common method of combating these pests is by flooding the burrows and killing the animals; grain soaked in poison is also used. The former method is long, tedious, and sometimes impracticable. During the summer of 1892 bisulphide of carbon was successfully used for their repression on the station farm. A ball of cotton about the size of an egg is thoroughly saturated with the bisulphide of carbon, or dried balls of horse manure may be used as an absorbent. About sundown when the animals are in their holes throw the cotton or manure ball into the burrow and close the opening with earth. This is also effective against prairie dogs and other burrowing animals.

METEOROLOGY.

Meteorological observations for 1892, D. B. BRACE (*Nebraska Sta. Bul. No. 26, pp. 57–84*).—Tabulated daily, monthly, and annual summaries of observations by M. M. Maghee, C. A. Skinner, A. O. Edgington, and G. Andrews on temperature, relative humidity, atmospheric pressure, movement of wind, soil temperature, and precipitation.

Meteorological summary for North Carolina, March, 1893, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Bul. No. 90d, Apr. 24, 1893, pp. 3–16, maps 2*).—Notes on the weather and tabulated daily and monthly summaries of observations by the North Carolina weather service, coöperating with the United States Weather Bureau.

Has the moon any influence on the weather? (*North Carolina Sta. Bul. No. 90d, Apr. 24, 1893, p. 17*).—An extract from a work on astronomy by Charles A. Young, in which the position is taken that "the multitude of current beliefs as to the controlling influence of the moon's phases and changes over the weather and the various conditions of life are mostly unfounded." (See this number of the Record, p. 876.)

SOILS.

W. H. BEAL, *Editor.*

Soil temperatures, D. B. BRACE (*Nebraska Sta. Bul. No. 26, pp 71–83*).—Tabulated daily, monthly, and yearly summaries of observations by A. O. Edgington and G. Andrews, during 1892, with thermometers at depths of from 1 to 36 inches.

FERTILIZERS.

W. H. BEAL, *Editor.*

Coöperative soil tests in 1892, A. J. BONDURANT and J. CLAYTON (*Alabama College Sta. Bul. No. 42, Jan., 1893, pp. 34*).—Notes and tabulated data for 27 experiments with fertilizers on cotton in as many counties of the State.

Fertilizers were applied as follows: Nitrate of soda 96 pounds per acre, muriate of potash 64 pounds, and acid phosphate 240 pounds, singly, two by two, and all three together; floats 240 pounds alone, and with nitrate of soda 96 pounds, or green cotton seed 848 pounds; cotton-seed meal 240 pounds with acid phosphate 240 pounds; and stable manure 4,240 pounds. Three check plats remained unmanured.

Thirty-six reports were received by this station from 42 experiments begun in 1891, and 27 out of 36 reported results in 1892, from which the following is gathered by comparing results for two years: Seven of these soils are deficient in the three main elements of plant food, and are benefited by the use of a complete fertilizer, * * * while eight of them are not deficient in potash. * * * In the balance of the experiments results are too conflicting for any conclusions to be drawn.

It will be found by comparing results of floats and nitrate of soda with floats and green cotton seed for two years, that only in one experiment has nitrate of soda with floats given best results, while fourteen give best results to floats with green cotton seed. The balance of the results are conflicting.

Experiments with commercial fertilizers on corn, D. D. JOHNSON (*West Virginia Sta. Bul. No. 29, Jan., 1893, pp. 83–95*).—The results obtained with dried blood, dissolved South Carolina rock, muriate of potash, sulphate of potash, and kainit on sixteenth or twentieth acre plats in four counties of the State are tabulated and discussed. In two counties drouth "so materially affected the results * * * as to render them almost valueless," and in general the results do not admit of definite conclusions.

FIELD CROPS.

A. C. TRUE, *Editor*.

Cañaigre, C. B. COLLINGWOOD, J. W. TOUMEY, and F. A. GULLEY (*Arizona Sta. Bul. No. 7, Feb., 1893, pp. 40, figs. 6*).—This bulletin gives the history, botanical characters, and geographical distribution of cañaigre (*Rumex hymenosepalus*), determinations of its tannic-acid content, and an account of experiments in the cultivation of the plant. The character of the soil in which cañaigre has been found growing in great abundance in the region of the station is shown by the following partial analysis: Sand, 93.44 per cent; silica, 2.50 per cent; ferric oxide, 1.13 per cent.

The soil looks like pure sand colored red by oxide of iron, and all passed through a sieve with meshes 0.5 mm. in diameter.

	Diameter in mm.	Per cent.
Medium sand	0.5–0.25	52.23
Fine sand	0.25–0.10	27.42
Very fine sand	0.1–0.05	12.13
Silt, by difference	0.5–	8.22

It has not been found growing in the extremely firm, close sedimentary soils, nor has it been found in soils containing more than 1 per cent of soluble salts.

The tannic-acid content of old and new roots collected in different parts of Arizona ranged from 22.5 to 35.6, and averaged 30.5 per cent.

The main results of the experiments at the station in growing cañaigre are stated as follows:

In July, 1891, plats on the university grounds were planted with cañaigre obtained from the Rillito Creek bottoms. The soil is a rather compact gravelly loam quite different from that on which cañaigre is usually found. No plants appeared above ground until October, but from that time the growth continued slowly and steadily all winter.

Hair-like roots had formed, and in a month these were 3 to 6 inches long and as large as a lead pencil. During the winter they were irrigated about once each month. Toward the last of March the tops began to grow rapidly, pushed up seed stalks, formed seed, and dried back by May 1. At this time the new roots averaged about 5 ounces. The content of tannic acid in dry sample was about the same as at the end of the first month. From June, 1892, until January, 1893, samples have been taken from undisturbed new roots for analysis.

Per cent of tannic acid in cañaigre roots at different dates.

June 4, 1892	16.7
August 2, 1892	18.2
September 13, 1892	23.1
October 15, 1892, average of new roots from 50 plants	23.0
Average of new roots from 50 plants	23.0
Highest	25.4
Lowest	15.7
November 16, 1892	24.4
January 10, 1893	25.0
January 17, 1893	28.2

October 15, fifty roots were weighed, cut in two, the lower half analyzed, the upper half planted. In most cases growth commenced at once. It is hoped in this way to determine, first, the exact increase in tannic acid, and second, whether roots high in tannic acid produce roots of the same character, and if so, to select seed for propagation, as was practiced successfully in the improvement of sugar beets. * * *

October 15, root No. 4 contained in green state 7.4 per cent, and in dry 22.2 per cent tannic acid. When dug, January 17, it had a bunch of six small roots 3 inches long, one-half inch in diameter.

The results of examination were as follows:

Analyses of the cañaigre plant.

	Weight.	Moisture.	Tannic acid. In fresh roots.	Tannic acid. In air-dry roots.	Tannic acid. Total weight.
	Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Grams.*
Old root	148.3	71.3	10.0	32.0	14.80
New root	39.2	76.4	3.9	15.1	1.52
Leaves and stems	94.0	80.0	0.8	3.9	0.79

From several analyses it would seem that the young roots at their inception have about 3.9 per cent tannic acid green, or 15 per cent to 16 per cent dry. At this time the roots are white, with a yellow ring, and do not turn red, even on exposure to the air. After blossoming the roots seem to have attained their full size, are somewhat deeper in color, and contain but little more tannic acid than when younger. Through

the long hot summer they gradually increase in tannic acid. As soon as they sprout and grow, there is a marked tendency to increase in tannic acid. Analyses of roots of the same age, sprouted and not sprouted, show the sprouted roots to have been uniformly higher in tannic acid.

Experiments in cultivation have not been carried sufficiently far to determine the effect on content of tannic acid. These, however, will be continued until definite results are reached as to best time to harvest roots. It may be found that two qualities of roots will be obtained; the first, one-year roots, with about 23 to 25 per cent of tannic acid, and only a small amount of coloring matter; the second, two-year roots, with higher percentage of tannic acid and large amount of coloring matter. * * *

Six tons of green root will make 2 tons of cut and dried root, and these 6 tons of green root can be made into 1 ton of extract; or, with one handling, the 6 tons of green root can be concentrated to 1 ton of extract containing the same amount of tannic acid. The saving of labor in handling will be enormous, besides leaving more money in the district growing the cañaigre and a bagasse which could be returned to the land, burned as fuel, or made a passable cattle food. As a cattle food it would have about the value of wheat straw.

In making extract it may be found desirable to use the green roots, cutting or shredding them, and then follow the so-called diffusion process by which sugar is obtained from beets and cane. * * *

Soil.—While the wild growth is confined to the sands and sandy loams, we find that if the roots are planted shallow and irrigated, equally large crops are produced on quite heavy soils and the roots are as rich in tannic acid. The plant seems not to be particular as to the kind of soil, provided it is kept sufficiently moist, and it may be found that our sandy loams and rather heavy soils may prove more profitable for growing the plant than lighter soils, owing to their greater fertility and more lasting qualities without fertilization. * * *

Seed.—Of the average sized roots of large growth, it will require about 1 ton per acre for seed, planting 9 by 30 inches. Unlike potatoes and most other plants grown from tubers, the seed roots are not lost, for after producing a growth of new roots the mother root, if but a year old, retains its weight and its content of tannic acid increases.

After removal from the ground, cañaigre roots, if piled in large heaps 4 or 5 feet deep, will heat and ferment; if in thin layers covered with dry earth, they may keep indefinitely two or three years, but when moistened they will sprout and grow. * * *

Planting.—It seems not to matter seriously when the roots are planted, the formation of new roots beginning in the fall from the latter part of September and continuing on until March or April. If planted in the late spring, leaves will appear and die down at the usual time in May, when the root planted will lie dormant through the summer and begin the formation of the new crop of roots at the regular season, with no apparent advantage or disadvantage as compared with roots planted just before the growing season.

If the soil is kept dry, they may lie over until the next year, and then proceed to grow in the usual way when moisture is supplied. * * *

The development of new roots the present winter on land that had been under cultivation before is greater than it was last year on new land, and we find also that thicker planting does not interfere with growth. From present indications rows 30 inches apart and plants 9 inches apart in the row will yield as much per hill as when the rows are planted 1 foot by 3 feet. * * *

Cultivation.—So far as we can judge of the habits of the plant, the yield of this crop will, like Irish potatoes and some other root crops, be largely governed by the preparation of the soil before planting. * * *

We have never found large cañaigre roots in close, compact soil, and we find that

it does not develop fully on our heavy soils under cultivation unless the soil is well broken and loosened up occasionally during the season of growth. * * *

The ground should be well plowed, the tubers dropped, and covered with the potato planter, which, with a little adjustment, will do the work. To secure largest yield the planting should be done before the first of October and the soil moistened. The crop should be irrigated from four to six times and some implement of the two-horse cultivator style with narrow teeth run through the rows after each irrigation to loosen up the soil.

Harvesting.—With the crop planted in the fall, growth above ground ceases the following May, but the roots, although they remain dormant, grow gradually richer in tannic acid during the year. The increase is, however, quite slow after July. With rain or irrigation in the fall, the leaves appear above the ground and a new bunch of roots is started, but so far as we have observed the entire hill will produce no more new roots than would single tubers if they are separated and replanted. In fact, we are inclined to think the single tuber will produce a larger new crop than the the entire hill. * * *

The potato digger will lift the roots from out of the ground, and this may be rigged with a carrier so that the roots will be dropped on a truck wagon driven alongside, somewhat on the plan of the grain header and accompanying wagon, and if the digger can not be rigged to dig two rows at a time, two or more may be driven on either side of the wagon used for hauling the roots from the field, the object sought being to exclude all hand labor in planting, digging, and picking up. * * *

Cost of growing.—With the field cleared, leveled, and put in shape to be irrigated, and seed on the ground, we would estimate the cost of growing somewhat as follows: Plowing and preparing land, per acre, $3; planting with machine, $2; irrigating and cultivating, $8; digging with machine, $2; water rental, $1.50; total, $16.50. * * *

General conclusions.—The amount exported during the past two years shows there is a demand at paying prices for large quantities, and one of the greatest obstacles in starting an industry, introducing a new product to the trade, is largely overcome. There is room for a large industry in growing and shipping the roots in a dry state, but the cost of labor in slicing and drying and the bulky condition of the product after it is thus prepared stands in the way of the most rapid development. * * *

It is important that extract factories be established on a large scale, and that they be located on lines of transportation where the lands in the immediate vicinity of the works may be planted to cañaigre. * * *

Corn experiments, C. L. NEWMAN (*Arkansas Sta. Bul. No. 22, Dec., 1892, pp. 68–72*).—Of 7 varieties of corn tested at the Pine Bluff Substation, Welborn Conscience gave the largest yield, 40½ bushels per acre.

White corn, carefully selected for seed, produced 4¼ bushels per acre more than seed corn of the same variety not selected. Selected yellow corn gave an excess of 2 bushels per acre over the unselected seed. The average increase due to selection was 3⅛ bushels per acre, worth, at 50 cents per bushel, $1.57¼.

Seed from the large end of the ear was compared with seed from the middle and small end. Seed from large end produced 34.2 bushels per acre; from middle, 30.8; from small end, 30.6.

The cost of growing an acre of corn was recorded. The crop was hoed twice and plowed three times. With labor at 65 cents per day and a single team at the same rate, a crop of 30.8 bushels per acre cost 22¼ cents per bushel.

Field experiments with corn, R. J. REDDING (*Georgia Sta. Bul. No. 20, Feb., 1893, pp. 1–14.*)

Synopsis.—The experiments are classified as follows: (1) General fertilizer experiment, in which the increased yield from the application of different fertilizers in no case paid for the cost of the fertilizer; (2) subsoiling, which did not increase the yield; (3) intercultural fertilizing, which was not advantageous; (4) fodder pulling, which was prevented by rainy weather; (5) deep *vs.* shallow culture, showing no difference in results between the two methods; and (6) composting in the heap *vs.* composting in the furrows, showing no advantage from the former practice. These experiments were as a rule continuations of those reported in Bulletin No. 15 of the station (E. S. R., vol. III, p. 604).

Corn, general fertilizer experiment (pp. 2–5).—In its main features this was a repetition of an experiment in 1891. A piece of fairly good clay soil, which had been in cotton the previous year, was divided into twenty-eight plats. The basal fertilizer consisted of a mixture of 312 pounds of superphosphate, 39 pounds of muriate of potash, and 65 pounds of nitrate of soda per acre. This was applied on three plats. In separate cases the single ingredients, two ingredients, and all three were doubled, three plats receiving the same fertilizer mixture in each case. On two plats cotton-seed meal was substituted for nitrate of soda. Two plats remained unmanured. The amount and cost of fertilizers applied and the yields of shelled corn are tabulated. Superphosphate and nitrate of soda produced decidedly beneficial results, but the application of muriate of potash was of doubtful advantage. The results with cotton-seed meal were conflicting. In general, the increased yield was in no case sufficient to pay for the cost of the fertilizer.

Corn, subsoiling (pp. 5–7).—An account of an experiment on fourteen plats, half of which were subsoiled. There was very little increase of yield from subsoiling. The application of nitrate of soda, 130 pounds per acre, April 13 and June 13, resulted in an aftergrowth of crab grass, from which enough hay was made after the corn had been removed to more than pay for the fertilizer.

Corn, intercultural fertilizing (pp. 7–9).—This was a repetition of the experiments of the two previous years.

The land selected for the experiment was 1 acre of red clay land, in cotton the previous year and producing about 1 bale to the acre with liberal fertilizing. The land was well prepared in a uniform manner, the first application of fertilizers made March 14, and the section was planted in Patterson's select corn March 16, covering with a hand hoe. The first intercultural application of fertilizers was made April 27 in the siding furrows on each side of each row of corn; the second application was made in the same way, May 12; the third application, May 26. Laid by, June 13.

The fertilizers used were superphosphate, muriate of potash, and nitrate of soda or cotton-seed meal. The results agree with those of the previous experiments in indicating no material advantage from fractional applications of fertilizers. Nitrate of soda gave somewhat better results than cotton-seed meal.

Corn, fodder pulling (p. 9).—It was intended to repeat the experiment

of the previous year in this line, but rain made it impracticable. It was found, however, that the time which would otherwise have been spent in pulling the fodder could be much more profitably used in filling a silo, and that the weather did not interfere with this work.

Corn, deep vs. shallow culture (pp. 9–11).—Alternate plats received deep and shallow cultivation, as in two previous years. There was practically no difference in the yields of corn from the two methods of cultivation. The extra cost of the deep plowing was not less than $1 per acre.

Corn, test of varieties (pp. 11, 12).—Brief notes on a test of 11 varieties.

Corn, composting in the heap vs. composting in the furrow (pp. 12–14).—A mixture of superphosphate 200 pounds, green cotton seed 1,000 pounds, and stable manure 1,000 pounds, was applied to corn after being composted in the heap four weeks, or was mixed in the furrow just before planting. The results agree with those of a previous experiment in indicating that there is no advantage from composting in the heap.

Field experiments with corn, W. C. LATTA (*Indiana Sta. Bul. No. 43, Mar., 1893, pp. 4–15*).

Synopsis.—The nature and results of the experiments reported are, in brief, as follows: (1) Early and late planting, results during four years favor early planting (May 1); (2) thick and thin planting, results during 7 years favor thick planting; (3) deep and shallow plowing, results during 2 years favor plowing about 8 inches deep; (4) deep and shallow cultivation, results during 5 years favor shallow cultivation; (5) test of cultivators, 7 different kinds; (6) rotation *vs.* continuous cropping, results during 5 years favor rotation; (7) effect of previous manuring, horse manure increased yield during 10 seasons; (8) full *vs.* partial applications of fertilizers, commercial fertilizers were not profitable in either case, but partial applications of horse manure gave a small profit; (9) number of days required to mature early and late planted varieties, about 110 days for the three varieties tested, without regard to time of planting; (10) test of varieties, tabulated data for 34 varieties. The experiments were in continuation of those reported in Bulletin No. 39 of the station (E. S. R., vol. III, p. 851).

Corn, early and late planting (p. 4).—In 1892 a medium early variety of corn was planted at different dates during the month of May. The largest yield was from the earliest planting, as in former years.

Corn, thick and thin planting (p. 6).—The yields in 1892, as well as the average yields for several years, from planting at five different distances, favor thick planting.

While the yield was increased by thick planting, the per cent of unmarketable corn was also slightly increased. The ears were, of course, also reduced in size, thus increasing the labor and expense of husking. If the corn is to be grown for silage, it is probable that even better results would be obtained by dropping the kernels of corn only 6 or 8 inches apart. If the crop is to be husked it will be well to drop the kernels 12 or 14 inches apart. This will secure larger ears and the saving in gathering will more than offset the slightly decreased yield due to thinner planting.

Corn, deep and shallow plowing (pp. 6, 7).—The yields of 1891 and 1892 from plowing to five different depths (4 to 12 inches) are tabula-

ted. The average results thus far show little difference in yield between 6 and 12 inches. Plowing 4 inches deep increased the yield in 1892, but not in 1891.

Corn, deep and shallow cultivation (p. 7).—In 1892 it made little difference in the yield whether the cultivation was 1, 2, or 3 inches deep, but the average results favor shallow cultivation.

Corn, test of cultivators (pp. 8, 9).—An account of a test of 7 different kinds of implements.

Corn, rotation vs. continuous cropping (pp. 9, 10).—The yields during five years (1888–'92) show an average of 34.78 bushels of corn on plats where corn, oats, and wheat were grown in rotation with timothy and clover, and 30.66 bushels where grain was grown continuously. No fertilizer has been applied since the beginning of the experiment.

Corn, effect of previous manuring (p. 10).—In 1883 and 1884 fresh horse manure, gas lime, and superphosphate were applied separately on land which had been in corn continuously since 1879.

Ten crops of corn have been grown since the first application of fertilizers and manure. The crop of 1887 is not considered, however, in calculating the results, as it was almost a total failure owing to severe drouth.

Both the gas lime and superphosphate have been practically without effect on the yields of corn. The horse manure has caused a considerable increase in yield of corn every year. The average increase for the horse manure is a trifle over 12 bushels per acre. This gives a total increase of a little more than 108 bushels per acre for nine crops. The increase in yield of corn was nearly 7 bushels per acre in 1892.

Corn, full vs. partial applications of fertilizers (p. 11).—The average yields of corn during three years indicate small increase of yield from either full or partial applications of commercial fertilizers. The application of 10,800 pounds of horse manure per acre increased the yield of corn nearly as much as 16,200 pounds, and gave a small net profit.

Corn, number of days required to mature early and late planted varieties (p. 12).—Purdue Yellow, Riley Favorite, and Yellow Nonesuch varieties, each planted May 24 and June 4 and 14, required about 110 days to grow to maturity without regard to the time of planting.

Corn, test of varieties (pp. 12–15).—A table gives number of days required to mature, yield of corn, and percentages of ears, shelled corn, shrinkage in curing, and barren and smutted stalks for 34 varieties grown at the station during one to five years.

The table shows a range (1) of thirty-three days in the time required to mature the several varieties; (2) of 44 bushels of corn and over 7,000 pounds of stalks in average yield per acre of the field varieties; (3) of 24 per cent in the average proportion of stalk and ear; (4) of 7.3 per cent in the average proportion of shelled corn; (5) of 23.4 per cent in the amount of shrinkage in curing; (6) of 18 per cent in the proportion of stalks without ears; (7) of 17 per cent in the proportion of smutted stalks; and (8) of 43 per cent in the proportion of smutted stalk without ears.

Detasseling corn, C. L. INGERSOLL (*Nebraska Sta. Bul. No. 25, Dec. 1, 1892, pp. 4*).—An account of an experiment in 1892 in continuation

of that reported in Bulletin No. 19 of the station (E. S. R., vol. III, p. 703). The tassels were removed July 23 from 10 alternate rows, 20 rods long, in the midst of a field of corn of 20 acres. A few days after the plat was gone over a second time to make sure that no tassel was left. The expense of detasseling was at the rate of $1.25 per acre. The yields of corn were as follows: On 10 detasseled rows, 528 pounds; on 10 alternate rows, 1,220; on 20 normal rows elsewhere in the field, 2,369. This agrees with the results of the previous year in showing a decrease in yield from detasseling.

Detasseling corn, G. C. WATSON (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 317–320*).—A report on an experiment in continuation of those recorded in Bulletin No. 40 of the station (E. S. R., vol. IV, p. 338). July 20, 1892, the tassels were removed from 44 rows, each containing 27 hills, in the midst of a field planted with Pride of the North corn.

The tassels were removed on alternate rows for the first 20 rows and on three fourths of the rows for the remaining 24 rows. That is, the tassels were removed from three rows and left on the fourth; removed from the next three and left on the fourth, and so on throughout the 24 rows. The tassels were removed as soon as they could be seen, and before they had expanded. The operation was performed by hand by giving the tassel an upward pull, which caused the stalk to break off above the upper joint without injuring the leaves at all.

From the three experiments made at this station in detasseling corn it has been observed that it is of the utmost importance to have the tassels removed at the earliest time possible, certainly before they have become expanded, and still better if inclosed within the folds of the leaf. The tassels may be readily removed by pulling as described above when inclosed in the leaf, if only the very tip of the tassel be exposed to view. And, further, it is essential that the tassels be removed in such a manner that the leaves are not in any way injured, which would be the case were they removed at the proper time by a corn knife.

The results, as given in detail in two tables, show a gain in the weight and number of both good and poor ears on the detasseled rows. The average increase in weight of good ears was 15 per cent, and of poor ears 26 per cent.

A new maize and its behavior under cultivation, L. H. BAILEY (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 332–338, figs. 2*).—"In 1888 the late Sereno Watson, of Harvard University, received from Prof. A. Dugès, of Guanajuàto, Mexico, some stalks and kernels of a wild corn which was found at Moro Leon, about four Mexican leagues north of Lake Cuitzco, near the southern boundary of the State of Guanajuato, in southern Mexico. The corn was wholly unknown to cultivation, and the natives of the district believe it to be the original source of the cultivated varieties of maize. This opinion is of great interest because the original form of Indian corn is wholly unknown. It is known among the natives as *mäis de coyote,* from the resemblance of the little kernels to dog's teeth. About a half dozen ears, in a cluster, were with the specimens sent to Harvard, each ear about 2 inches long and bearing a few rows of very small pointed white kernels."

In 1889 the author made an unsuccessful attempt to grow two or three kernels of this corn given him by Mr. Watson. In 1890 it was grown at the botanic gardens at Cambridge, Massachusetts, but only a few kernels matured.

The tallest stalks were over 10 feet high, with a diameter of nearly 2 inches. But the most striking peculiarity of the plants was the abundance of lusty suckers, which "grew as rapidly as the main stalk, so that the plants, which had fortunately been placed some feet apart, had the appearance of two hills, one of the two having nine and the other twelve stalks ascending from a common base." The central stalk also branched higher up on its trunk, and these side branches, as also those from the base of the plants, had a tassel upon the end and bore several ears along their length. The tassel was very large, with drooping branches. * * *

Mr. Watson concluded that this corn is a new and distinct species rather than the original of the common corn, and he therefore published it[1] as *Zea canina*, or dog-tooth corn, thus adding a second species to the genus *Zea*.

In 1891, I grew the corn again from the original Mexican samples—which Mr. Watson divided with me—starting it late under glass (May 22), and setting it out of doors June 12 in a heavy clay loam, when about half a foot high. The plants grew vigorously, and ears began to form late in summer, being borne upon strong lateral branches as before. The illustration in the bulletin shows a typical plant, having six arms or branches springing from the main stalk. A dozen or fifteen ears set upon these arms. * * *

These plants appeared to differ from those which I saw at the Harvard Botanic Garden the year before only in size and earliness. The smaller size may have been due to the soil, which was poorer than at Harvard, but I thought I saw a decided tendency toward acclimatization in the plants, and this is now apparently warranted by the results of this year's experiment. Some of the plants did not make lateral arms, but simply sent up a straight almost earless stalk. Perhaps this was due to the fact that the plants were crowded. Some of the plants matured several good ears.

[Crosses were made by the author in 1891 of the new corn with Extra Early Marblehead sugar corn and Japanese striped corn (*Zea japonica*)]. The one Canina × Marblehead plant grew scarcely more than 4 feet tall. Two suckers sprung from the base of the plant, but there were no branches higher up, and all the ears were small and single. The kernels, which had been pollinated from the tassels on the same plant, were indistinguishable from those of true Canina. * * *

The fourteen Canina × Japanese plants grew with great vigor, reaching a height of 8 and 9 feet, and nearly all the stalks produced the branches of multiple ears. But the remarkable feature of these plants was the shortening up of these side branches from the length of 2 and 3 feet, attained in true Canina, to a cluster or brace of four to six ears. One plant which produced three stalks from the base, bore four sets on one stalk, five on another, and twenty-five on the main stalk, making a total of 34 ears from one seed. * * *

Some plants among these hybrids, however, produced single ears, but the greater number of them made from a dozen to twenty sets, and perhaps half the ears matured. The kernels in these remarkable hybrids are both yellow and white, although yellow is far the most prominent, and they are rounded like the Japanese, but bear a minute point or mucro, in memory of their Canina parentage.

The ears are twice larger than those of the Canina, from which they came. Two plants of the fourteen had distinctly striped foliage, like the Japanese corn.

The plants of true Canina which grew near by were less branched than the Canina × Japanese, and while most of the ears were multiple, some were single.

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[1] Proc. Amer. Acad. Arts and Sci. xxvi, p. 158.

This corn was also attacked by smut. The behavior of these plants indicate either that Canina is variable or that it tends to lose its characters under cultivation. I am inclined to adopt the latter explanation, especially as another lot of Canina grown in the field alongside a plantation of sweet corn showed similar degeneration to single ears. * * *

It may be worth while to inquire if this Canina corn still retains a specific identity—if it really is a distinct species from the common corn, *Zea mays*. For myself, I am strongly of the opinion that it is not a distinct species. I am rather inclined to think, with the native Mexicans and Prof. Dugès, that it is the original form of *Zea mays*, or at least very near it. It explains many points in the evolution of Indian corn. Some varieties of sweet corn occasionally produce rudimentary multiple ears, and this Canina seems to tend to lose them under cultivation. The tendency of cultivation in all plants is to develop some fruits or some organs, rather than all fruits or all organs. The suckering habit has been discouraged in the selection of corn. The tendency to sucker and to produce tassels on the ends of ears, the profuse drooping tassels of many little-improved varieties, the predominance of flint corn northward and of dent or pointed corn southward, the occurrence of many curious and aboriginal varieties in the Aztec region—all these become intelligible if *Zea canina* is the original of Indian corn.

Field experiments with cotton, R. J. REDDING (*Georgia Sta. Bul. No. 20, Feb., 1893, pp. 14–28*).

Synopsis.—The experiments are classified as follows: (1) Variety test, in which Bates Big Boll cotton gave the largest yield and highest per cent of lint; (2) distance experiments, in which the heaviest yield was produced by the plants which were 4 feet by 1 foot apart; (3) a test of the effect of increasing the amount of fertilizer, in which every increase of the fertilizer produced an increase in the yield; (4) a general fertilizer test, in which phosphoric acid was most effective, and nitrogen also effective, while potash gave negative or doubtful results.

Test of varieties (pp. 14–16).—Twenty-five varieties of cotton were tested. The yield at each picking, total yield, and per cent of lint are tabulated.

Bates Big Boll gave the largest yield of seed cotton (1,742 pounds per acre) and the highest per cent of lint (34.75). Tennessee Gold Dust and King matured more than three fourths of their total crop before October 1. Okra Leaf was also early.

Distance experiment (pp. 16–19).—This experiment and the succeeding fertilizer tests are repetitions of experiments reported in Bulletin No. 16 of the station (E. S. R., vol. III, p. 691). The varieties used were Pittman Improved (cluster) and Truitt Improved. The rows were 4 feet wide and the plants were left at distances of 1, 2, 3, and 4 feet in the drill. The yield for each picking, total yield, and average yield per stalk are tabulated.

The average yield of the two varieties was greatest (1,616 pounds seed cotton, or 521 pounds of lint per acre) when the distance was 4 feet by 1 foot. Close planting hastened the maturity of the plant, and hence is recommended for high latitudes. The author concludes that on land capable of producing more than a bale per acre the distance should be about 1 by 4 feet; on land capable of yielding more than a bale the distance should be greater, probably 2 by 4 feet.

Effect of increasing the amount of fertilizer (pp. 20-23).—The same rows were used as in a similar experiment in 1891.

The fertilizer used consisted of a mixture of 60 pounds of superphosphate, 15 pounds of muriate of potash, and 25 pounds of nitrate of soda. This mixture was applied at the rate of 200, 400, 600, 800, 1,000, and 1,200 pounds per acre. One set of rows was unfertilized. The test was repeated on seven sets of rows, using two varieties of cotton. The yields at each picking of the series of rows receiving different amounts of fertilizer are tabulated. An increase in the amount of fertilizer increased the yield.

"Successively increasing amounts of fertilizers do not result in the same ratio of increasing yields of cotton. It follows that the larger the amount of fertilizers the greater will be the resulting cost of the increase per pound; but at the same time there will be left in the soil a correspondingly larger amount of fertilizer for the use of the succeeding crop.

"The liberal use of judiciously compounded fertilizers affords a larger investment upon which the percentage of profit is to be based, and is therefore advisable."

The Truitt, whose plants are symmetrically formed and rather under medium size, with large bolls, proved more productive under high fertilization than the Pittman, a tall-growing variety with short laterals and clustered medium-sized bolls.

General fertilizer experiment (pp. 23-28).—For this experiment 102 plats were used, of which 12 plats were unfertilized. On the other plats, superphosphate, 156, 312, and 468 pounds per acre; muriate of potash, 39, 78, and 117 pounds; and nitrate of soda, 55, 130, and 195 pounds were variously combined with each other. Muriate of potash, 111 pounds, and superphosphate, 143, 286, and 429 pounds, respectively, were also combined with 429 pounds of cotton seed meal.

The author concludes that—

(1) Phosphoric acid was the most effective in increasing the yield of cotton on the soil covered by the experiment.

(2) Potash was not required except when liberal amounts of the other two elements were applied. The behavior of potash, at least in the form of muriate, was uncertain and even erratic, and it is not certain, on the whole, that it increased the yield.

(3) Nitrogen is very effective in medium quantity, say two rations, in combination with three rations of superphosphate.

(4) Cotton-seed meal is equally as effective as nitrate of soda, in the combinations of the other elements, as a nitrogenous plant food for cotton.

(5) The most effective combination of the three ingredients employed in this experiment on this soil was:

468 pounds superphosphate, equal to 66 pounds phosphoric acid;
78 pounds muriate of potash, equal to 39 pounds potash;
130 pounds nitrate of soda, equal to 20 pounds nitrogen.

Flat pea, O. CLUTE and F. B. MUMFORD (*Michigan Sta. Bul. No. 91, Feb., 1893, pp. 9-13*).—The flat pea (*Lathyrus sylvestris*) has been grown

on a small scale for two years at the Michigan Station and at the Grayling Substation. From this experience the following conclusions are drawn:

(1) It germinates and reaches the surface in from 17 to 28 days.

(2) It grows slowly at first after reaching the surface, and needs care to keep weeds down.

(3) It makes on very poor unimproved sandy soil a top growth of 6 to 8 inches, and a root growth of 12 to 15 inches the first year.

(4) It makes on sandy soil that has been cultivated and improved a top growth of 12 to 15 inches, and a root growth of 18 to 24 inches the first year.

(5) The tops are not easily cut down by frost. The roots go through the winter well.

(6) The roots are thickly supplied with tubercles.

(7) One-year-old plants transplanted in the spring to sandy soil gave at the rate of 10,460 pounds of green forage per acre.

(8) It does not bloom the first year. With us the blooms, pods, and seeds have been few the second year.

(9) Cattle eat the green forage readily.

Experiments with oats, 1892, G. E. MORROW and F. D. GARDNER (*Illinois Sta. Bul. No. 23, Nov., 1892, pp. 121–136*).

Synopsis.—The nature and results of the experiments reported are in brief as follows: (1) Quantity of seed, 2.5 to 3.5 bushels per acre gave largest yields; (2) compact *vs.* loose seed bed, medium compactness favored; (3) time of sowing, early seeding favored; (4) depth of sowing, 1 inch better than a greater depth; (5) test of varieties, data for 59 varieties; (6) time and manner of harvesting, best results when straw was green and kernels mostly in dough and when sheaves were bound and shocked at once. The experiments were in continuation of those reported in Bulletins Nos. 12 and 19 of the station (E. S. R., vol. II, p. 400; III, p. 779). The soil used was fertile, dark-colored prairie loam.

Oats, quantity of seed (pp. 123, 124).—Early Dakota oats were sown on 14 plats, each 2 by 4 rods, at the rate of from 1 to 4 bushels per acre. The yields per acre of grain and straw during five years and the averages for the five years are given in the following table:

Yields of oats from different rates of seeding, 1888–'92.

Seed per acre.	Grain per acre.						Straw per acre.					
	1888.	1889.	1890.	1891.	1892.	Average.	1888.	1889.	1890.	1891.	1892.	Average.
Bushels.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	52.5	36.3	25.3	36.7	40.5	38.3	3,820	4,600	2,820	1,275	1,742	2,851
1.5	59.4	33.1	21.6	56.9	43.5	42.9	4,400	3,800	1,740	1,970	1,980	2,778
2	61.4	42.5	17.5	74.8	43.3	47.9	4,540	4,000	1,800	2,748	1,832	2,984
2.5	63.8	43.8	29.1	72.6	44.5	50.8	4,860	3,000	2,460	2,638	1,935	2,979
3	61.9	47.2	27.5	76.6	44.3	51.5	5,220	4,400	1,960	2,790	2,100	3,294
3.5	62.5	52.1	24.7	79.7	42.4	52.3	4,400	4,100	2,000	3,060	1,952	3,102
4	60.6	50.6	21.9	76.3	43.2	50.5	4,260	3,200	2,020	3,110	2,377	2,993

Oats, compact vs. loose seed bed (pp. 124, 125).—Early Dakota oats were sown broadcast at the rate of 2.5 bushels per acre April 12, 1892, with the following results:

Yields of oats sown in differently prepared seed beds, 1892.

Preparation of seed bed.	Yield per acre.	
	Straw.	Grain.
	Pounds.	*Bushels.*
Plowed 4 inches deep, seeded, and harrowed	2,140	41.9
Seeded, disked, and harrowed	2,030	42.2
Disked, seeded, harrowed, and rolled	2,180	43.8
Seeded and plowed 4 inches deep	1,755	42.7
Disked, seeded, and harrowed	3,170	47.2
Seeded, disked, harrowed, and rolled	2,150	44.7
Seeded and harrowed	1,735	40.8

The average results per acre during four years were: Compact seed bed, grain 46.2 bushels, straw 2,896 pounds; medium seed bed, grain 48.1 bushels, straw 3,225 pounds; loose seed bed, grain 43.6 bushels, straw 2,662 pounds.

Oats, time of sowing (pp. 125–127).—The average yields of grain per acre from seeding at different dates on duplicate plats in 1892 were as follows: March 30, 46 bushels; April 6, 42.4 bushels; April 13, 47.7 bushels; April 21, 41.7 bushels; April 27, 42.4 bushels; May 4, 23.9 bushels.

"Taking the average for four years, the maximum yield of grain is in favor of seeding March 28 to 31, with but little difference any time between March 22 and April 16.

"The weight per bushel uniformly decreases with the lateness of seeding."

Oats, depth of sowing (p. 127).—Tabulated data are given for an experiment in which oats were seeded at depths of from 1 to 6 inches. The yield decreased as the depth of seeding increased. This agrees with the average results during five years.

Oats, tests of varieties (pp. 128–136).—Notes and tabulated data for a test of 59 varieties in 1892, and comparative data for 30 varieties tested four years and 44 varieties tested three years. The varieties which have given an average yield of over 45 bushels per acre during four years (1889–'92) are as follows: Pringle Progress, New Dakota Gray, Japan, New Red Rust-proof, Early Dakota, Texas Rust-proof, Improved American, American Banner, Black Russian, Giant Yellow French, White Bonanza, Prize Cluster, Welcome, White Russian, Black Prolific, Clydesdale, Common Mixed, Badger Queen, and White Wonder.

The vitality of the seed of each variety was tested in the Geneva apparatus. Nine varieties showed perfect germinating power; of 9 varieties the average per cent germinating was less than 90, the lowest 74, the next lowest 80. The average yield of the 9 varieties with highest per cent was 4 bushels per acre more than the average of the 9 with lowest germinating power.

Oats, time and manner of harvesting (pp. 134–136).—Tabulated data are given for experiments in which oats were harvested July 6, 11, and 17 in 1891, and July 16, 22, and 30 in 1892, or in milk or dough, medium ripe, and fully ripe. Comparisons were also made between (1) oats bound and shocked soon after cutting, (2) cut and dried in the swath before binding, and (3) heads cut, the stalks being left in the field.

"Slightly better results were obtained when the oats were harvested while the straw was still green and the kernels mostly in the dough stage than when the straw was mostly yellow and the kernels hard. When the oats were allowed to mature fully, the results were distinctly less satisfactory. When the sheaves were bound and shocked at once, the yield was somewhat better than when the cut straw was allowed to dry thoroughly before the sheaves were bound."

The wild potato of the Mexican region, L. H. BAILEY (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 350–352, fig. 1*).—"About 1878 Dr. W. J. Beal, of the Michigan Agricultural College, received from the Harvard Botanic Gardens a few tubers, the largest about an inch in diameter, of a wild potato from Mexico. This potato has been grown since that time at the Michigan College, and we have grown it here two or three years from the Michigan seed."

The tubers are gradually improving, and in 1887, when I made a report upon this potato (Bulletin No. 31 of the Michigan Station) the best tubers measured 3 inches in length. The largest tubers now reach over 4 inches in length, and the number of small potatoes in the hills seems to be lessening. The tubers are brown with deep eyes, and tend to be flattened. They keep well. The flesh is very yellow. When cooked the flavor is rich, and possesses a slight aroma which is not present in the common potatoes. The plants usually produce balls freely.

The potato is probably the *Solanum tuberosum*, var. *boreale* of Gray, although it has the interposed small leaflets which that plant is supposed to lack. It occurs in a wild state from the Montezuma Valley, Colorado, to New Mexico and southwards in the mountains in Mexico. This wild potato of the North appears to have been first brought to notice in 1856 by Dr. A. J. Myers, of the U. S. Army, who found it in western Texas. * * * This plant was grown in 1888 by the Colorado Experiment Station (Bul. No. 4) from wild Colorado tubers. The tubers under cultivation were "quite large relatively to the other forms (samples of *Solanum jamesii*), oblong in shape, and of a dark brown color."

Experiments with potatoes, L. R. TAFT, H. P. GLADDEN, and R. J. CORYELL (*Michigan Sta. Bul. No. 90, Feb., 1893, pp. 19–30*).—These were in continuation of experiments reported in Bulletin No. 85 of the station (E. S. R., vol. III, p. 872), and included tests of varieties and of fertilizers.

Potatoes, tests of varieties (pp. 19–24).—Tabulated data are given for 134 varieties, and descriptive notes on 19 new varieties.

Potatoes, fertilizer tests (pp. 24–28).—Nitrate of soda or sulphate of ammonia, ground bone, or dissolved boneblack, and sulphate or muriate of potash were applied in different combinations. Manure was used on several plats, and mulching between rows was tried on one plat. Fertilizers under the seed produced the best results in 1891, but in the wet

season of 1892 applying the fertilizer over the seed gave the largest yields. Mulching was not as beneficial in 1892 as in the previous year. The addition of nitrate of soda or sulphate of ammonia to bone and potash was not profitable. Manure was more profitable than commercial fertilizers.

Potatoes, diseases (pp. 28-80).—Notes on the treatment of potato scab and on an undetermined disease which somewhat resembled ordinary blight, but could not be checked with Bordeaux mixture.

Experiments with potatoes, E. S. RICHMAN (*Utah Sta. Bul. No. 20, Mar. 1893, pp. 1-15*).—Brief accounts of experiments on (1) amount of irrigation, (2) methods of irrigation, (3) planting whole tubers *vs.* cuttings, (4) large *vs.* small tubers for seed, (5) effect of manure on quality, (6) depth of plowing, (7) methods of cultivation, and (8) test of varieties. A previous report on experiments with potatoes was published in Bulletin No. 5 of the station (E. S. R., vol. II, p. 664).

Potatoes, amount of irrigation (pp. 1, 2).—From 1 to 4 inches of water per acre was applied on different plats. The yield increased with the amount of water applied up to 3 inches.

Potatoes, methods of irrigation (p. 3).—Flooding the ground so as to cover it with water gave better results than allowing the water to run between the rows in the furrows made by the cultivator.

Potatoes, planting whole tubers vs. cuttings (pp. 3-5).—The following table gives the number of pounds of tubers produced on twentieth-acre plats from planting whole tubers and cuttings during three years:

	1890.	1891.	1892.
	Pounds.	*Pounds.*	*Pounds.*
Single eyes	....	124	333
Two eyes	327	398	565
Quarters	399	422	....
Halves	470	530	544
Whole tubers	485	631	828

Seed ends of potatoes gave a smaller total yield than stem ends, but the yield of large potatoes favored the seed end.

Potatoes, large vs. small tubers for seed (pp. 5, 6).—In 1890 and 1891 the results favored the large tubers, but in 1892 the small tubers gave the largest yield.

Potatoes, effect of manure on quality (pp. 6, 7).—In 1892 potatoes grown with manure had a smaller starch content than those grown without manure; but in 1890 the reverse was true.

Potatoes, depth of plowing (pp. 7, 8).—Plowing from 3 to 9 inches deep for potatoes, carrots, peas, and cabbages during two years has given inconclusive results.

Potatoes, methods of cultivation (p. 8).—Pulverizing the soil for potatoes, peas, and cabbages did not give so good results as simply harrowing it.

Potatoes, test of varieties (pp. 9–15).—The yields of 32 varieties are given, the largest being by Burpee Superior, Lee Favorite, Compton Superior, Cream City, and Early Standard.

Experiments on potatoes, D. D. JOHNSON (*West Virginia Sta. Bul. No. 29, Jan., 1893, pp. 71–83*).—This is a repetition of experiments on completely worn-out soil reported in Bulletin No. 20 of the station (E. S. R., vol. III, p. 807), on "(1) the comparative yield of large and small tubers of the several varieties produced by the use of different fertilizers; (2) the increased yield produced by different fertilizers, their cost, and profit and loss; and (3) the comparative yield of tubers planted whole, in halves, quarters, and cut to single eyes."

"The crop this year was almost a complete failure, caused by the unfavorable season and the exhausted condition of the soil." The results, however, are tabulated in full and confirm in detail those obtained in the previous experiment. From the two years' experiments the following conclusions are drawn:

> The best results in commercial fertilization, as tested, were secured by a combination of potash and phosphoric acid in the ratio of 2 to 1. There was no material benefit, but an actual loss, in the use of nitrate of soda. The best results in the preparation of the seed can be secured by so cutting the tubers that each piece will produce one strong, vigorous stalk, and by planting from two to four pieces in each hill, according to the distance the hills are apart.

Experiments with potatoes, mangel-wurzels, and carrots, H. T. FRENCH (*Oregon Sta. Bul. No. 24, Mar., 1893, pp. 12*).—Notes and tabulated data for tests of 59 varieties of potatoes, 11 of mangel-wurzels, and 13 of carrots, grown on clay loam soil, such as is common in the Willamette Valley. An account is also given of a test of fertilizers for potatoes in which the yield was largely increased by the application of Peruvian guano, superphosphate, or kainit. The varieties which gave the largest yields were as follows:

Potatoes.—Riley, Champion, Dakota Red, Early Rose, Sultan, Commander, Thorburn Late Rose, and Tilden.

Mangel-wurzels.—Orange Globe, Eschendorf, Giant Yellow, and Kniver Globe.

Carrots.—Long White Belgian, Yellow Belgian, White Vosges, and Mastodon.

Results of chemical analyses of tobacco cured by the leaf-cure on wire and the stalk processes, F. B. CARPENTER (*North Carolina Sta. Bul. No. 90a, Apr. 14, 1893, pp. 34*).

Synopsis.—Analyses showing the per cent of nitrates in tobacco at different stages of growth; analyses of the whole leaves, midribs, leaves exclusive of midribs; organic and ash analyses of leaf, stem, and stalk, cured by the leaf-cure on wire and the stalk processes. The difference in chemical composition of like grades from the two methods of curing is chiefly due to the manner and time of harvesting.

This bulletin is supplementary to Bulletin No. 86 of the station (E. S. R., vol. IV, p. 32), and gives the chemical data secured in a comparison

of the leaf-cure and stalk-cure processes. The influence of the two methods of curing on the chemical composition of tobacco is studied. From the tables of analyses given the following table is quoted:

Analyses of whole tobacco leaf (including midrib), calculated to a sand-free and water-free basis.

Grade of leaves.	Nicotine.	Resin and fatty substances.	Albuminoids.	Nitric acid.	Ammonia.	Cellulose.	Ash.
Cured by the stalk process.							
Smokers:	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Scrap from stalk	2.78	10.38	9.95	0	0.134	10.19	12.72
Scrap	2.09	8.00	6.88	0	0.124	10.91	13.34
Trash lug	2.07	7.56	5.65	0	0.133	10.86	14.15
Best lug	2.05	7.44	6.55	0	0.110	10.30	12.08
Cutters:							
Sand lug	2.32	8.21	6.52	0	0.115	9.56	12.94
Best lug	2.64	7.46	6.29	0	0.109	9.55	12.44
Wrappers:							
First grade	2.73	7.33	7.03	0	0.129	9.42	11.99
Second grade	2.72	7.39	6.77	0	0.123	9.40	11.70
Fillers:							
Bright tips	2.75	7.82	7.75	0	0.140	9.28	10.10
Black tips	2.02	7.14	8.04	0	0.119	9.39	10.70
Leaves for comparison (W)*	2.50	6.76	7.38	0	0.111	8.59	11.48
Cured by the leaf process on wire.							
Smokers:							
Scrap	2.30	6.34	7.16	0	0.151	11.90	15.25
Trash lug	2.01	6.51	6.11	0	0.125	10.79	15.19
Best trash lug	2.16	7.16	7.15	0	0.143	10.07	13.52
Cutters:							
Sand lug	2.29	7.09	7.36	0	0.136	9.92	12.79
Best lug	2.23	7.15	7.18	0	0.133	9.53	13.14
Wrappers:							
First grade	2.44	6.90	6.69	0	0.157	9.82	12.56
Second grade	2.83	6.91	9.05	0	0.141	9.99	12.22
Fillers:							
Bright tips	2.85	6.95	9.65	0	0.151	9.62	10.63
Black tips	2.88	5.51	11.22	0	0.179	9.38	11.77
Leaves for comparison (X)*	2.45	6.42	7.28	0	0.130	8.60	11.09

*W and X were harvested and cured under the same conditions, except that W was left on the stalk during the curing process.

The difference in chemical composition of like grades resulting from the two methods of curing is chiefly due to the manner and time of harvesting. This difference is most noticeable in case of the fillers, where the increased growth, caused by priming the lower leaves in the leaf-curing process, has made a large increase in the percentage of albuminoids and nicotine. * * * The priming process, as followed in the leaf-cure method, has a marked effect on the growth and chemical composition of the leaves taken from the upper part of the plant. The removal of the lower leaves caused the top of the plant to grow with increased vigor, thus producing heavier and coarser leaves, with a considerable increase in the percentage of organic nitrogenous matter and nicotine. While the quality is somewhat injured by this transformation, it appears that the gain in weight more than compensates for the loss in quality. * * * The presence of a large percentage of carbohydrates, especially starch and glucose, is characteristic of the yellow tobacco grown on the light, sandy soil of Granville County.

By means of analyses made when the plants were at different stages of growth, it was learned that the nitrates are confined almost entirely to the stalk and stems in the younger growth of the plant, while the

other nitrogenous substances are more abundant in the leaves. The analyses of the whole leaves, midribs, leaves exclusive of midribs, and organic and ash analyses of leaves, stems, and stalks are prefaced by a description of the chemical methods used in making the analyses. The bulletin also contains a tabular statement of the value of tobacco produced by the two systems of curing, and analyses of a number of varieties of tobacco grown in different parts of the United States.

The following table gives the analysis of the top soil and subsoil from a tobacco field near Oxford, North Carolina, which is very closely representative of the general character of the best bright tobacco soil:

Analysis of tobacco soil and subsoil.

	Top soil.	Subsoil.
	Per cent.	*Per cent.*
Coarse materials	7.05	3.95
Fine earth	92.95	96.05
	100.00	100.00
Analysis of fine earth.		
Insoluble matter	95.642	94.870
Soluble silica	0.938	1.476
Potash (K_2O)	0.161	0.057
Soda (Na_2O)	0.109	0.232
Lime (CaO)	0.240	0.265
Magnesia (MgO)	0.047	0.056
Peroxide of iron (Fe_2O_3)	0.326	0.488
Alumina (Al_2O_3)	1.038	1.872
Phosphoric acid (P_2O_5)	0.016	0.000
Sulphuric acid (SO_3)	0.055	0.072
Water (H_2O)	0.312	0.286
Volatile matter	1.510	1.050
	100.394	100.724

Effect of fertilizers on tobacco, G. C. WATSON (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 320–322*).—A brief account of an experiment in which barnyard manure and sulphate or chloride of potash with nitrate of soda and superphosphate were compared with no manure on 4 fortieth-acre plats of heavy clay loam of poor quality. Barnyard manure gave the largest yield, but was not more profitable to use than the commercial fertilizers. Sulphate of potash gave somewhat better results than chloride.

Sorghum and sugar cane culture, C. L. NEWMAN (*Arkansas Sta. Bul. No. 22, Dec., 1892, pp. 72–79*).—Directions for growing a crop of sorghum and sugar cane.

Spurry, O. CLUTE and O. PALMER (*Michigan Sta. Bul. No. 91, Feb., 1893, pp. 3–8*).—Authorities are quoted to show the prominent position which spurry (*Spergula arvensis*) holds in European agriculture.

On the sandy plains of Michigan at the Grayling Substation it has been successfully grown for five years, and has resisted cold and drouth. It has proved valuable for pasture and hay, but is chiefly prized as a renovating crop for soil too light for clover. On unimproved sandy soil it

makes a dense growth of vine, from 12 to 15 inches in height. It thrives in dry, sandy soils. The yield of seed, secured by threshing, is from 8 to 12 bushels per acre.

For green manuring or forage, from 6 to 8 quarts should be sown per acre; if destined for seed, 4 quarts is sufficient. Spurry germinates promptly, is ready for pasturage in from 4 to 6 weeks, and may be mowed 6 weeks after sowing. When the first crop is not cut for seed till quite ripe, the plant reseeds itself, and thus two crops a year may be secured. Cattle at first refuse to pasture on spurry, but soon become very fond of it, eating the green plant and even the threshed straw with relish. Horses do not like it.

A crop of spurry turned under makes sandy land much more compact than before. The grasses make a more even sward, and are less inclined to grow in bunches when they follow spurry. Wheat grows much better after spurry than after the usual farm crops.

Spurry seed has been distributed among the farmers on the sandy plains, and their letters, which are quoted, speak highly of spurry as a forage plant and as a fertilizer for sandy soils.

"On the plains it has not proven troublesome as a weed, but it may be well to be cautious on this point when the crop is grown on richer soil."

Sugar beets in Indiana in 1892, H. A. HUSTON (*Indiana Sta. Bul. No. 43, Mar., 1893, pp. 16–19*).—Tabulated data are given showing the results of analyses and conditions of culture for about 40 samples of beets grown in different parts of the State, and for a number of samples of beets grown at the station. The season was decidedly unfavorable to this crop. In some cases the beets yielded 15 per cent of sugar, but the average was much below this. Damage to the crop was caused by blister beetles, leaf-spot (*Cercospora betæ*), and the bacterial disease described in Bulletin No. 39 of the station (E. S. R., vol. III, p. 853).

The vetch or tare as an orchard plant, L. H. BAILEY (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 354, 355*).—The European vetch (*Vicia sativa*) was sown broadcast June 16 in an orchard of young pear, plum, and apricot trees on heavy clay loam. The vetch started slowly, but by the middle of September the ground was covered thickly. It continued to grow until the middle of October, and remained green still longer.

With the approach of hard freezing weather the stalks fell upon the ground, where they now lie like a thin even covering of old hay. The stems are soft and can be easily plowed under in spring and will soon decompose; and they will not keep the soil wet too late in spring, which is an important point upon clay soils. On the whole we are much pleased with the vetch as an orchard plant, and shall use it again.

Experiments with wheat, 1891–'92, G. E. MORROW and F. D. GARDNER (*Illinois Sta. Bul. No. 22, Aug., 1892, pp. 105–120*).

Synopsis.—The nature and results of the experiments reported were in brief as follows: (1) Quantity of seed, largest yields from seeding 5 or 6 pecks per acre; (2) time of sowing, any date in September better than later; (3) depth of sowing, little difference between 1 and 3 inches, but covering 5 inches reduced the yield; (4) effect of fertilizers, on rich prairie soil at the station fertilizers had no effect, but on lighter soils in southern Illinois they increased the yield; (5) test of varieties, data for 57 single varieties and 4 mixtures; (6) time and manner of harvesting, increase of yield from earliest to latest cutting, and best results from drying stalks with heads in the shade. The experiments were in continuation of those reported in Bulletin No. 17 of the station (E. S. R., vol. III, p. 215).

Wheat, quantity of seed (pp. 107, 108).—Notes and tabulated data are given for an experiment on 6 plats seeded October 6, 1891, at the rate of from 4 to 8 pecks per acre. The yields of grain were from the 4 pecks, 24.7 bushels per acre; 5 pecks, 29 bushels; 6 pecks, 26 bushels; 8 pecks, 27.8 bushels. During four years the highest average yields have been from seeding at the rate of 5 or 6 pecks per acre.

Wheat, time of sowing (p. 108).—An account of an experiment in which wheat sown September 2 yielded 29.1 bushels per acre; September 11, 28.4 bushels; September 21, 26.7 bushels; October 5, 27.2 bushels; October 13, 21.7 bushels. During 4 years seeding in September has given higher yields of grain than seeding in October, but there has been very little difference in the yields from seed sown at different dates in September. "The yield of straw has generally decreased from the first to the last sowing."

Wheat, depth of sowing (p. 109).—A small experiment is reported in which wheat was seeded at depths of 1, 3, and 5 inches. There was little difference in the yields from the first two depths, but the seed covered 5 inches yielded considerably less.

Wheat, effect of fertilizers (p. 109–111).—Notes and tabulated data are given for experiments with barnyard manure, bone meal, and bone and blood at the station and at four localities in southern Illinois. At the station the fertilizers produced little or no effect. At the other places the commercial fertilizers increased the yield, but not so much on the average as the barnyard manure.

Wheat, test of varieties (pp. 112–118).—Tabulated data are given for a test of 57 varieties of wheat in 1891, and in a number of cases comparisons are made between the tests at the Illinois, Ohio, and Indiana stations the same year. Data are also given for the yields from 4 mixtures of different varieties. Twelve of Carter's cross-bred varieties imported from England were failures.

Of the red bearded varieties the following gave yields of 30 bushels or more an acre, averaging over 33 bushels; Hindustan, Diehl Mediterranean, Deitz, Tuscan Island, Lehigh, Crete, Tasmanian Red, Velvet Chaff, Nigger, Golden Cross, New Longberry Wabash, and Lebanon.

Of red bald varieties, Poole, Currell Prolific, Longberry, and Improved Rice gave yields of 30 to 32 bushels per acre.

Of white bald varieties Golden Prolific gave 30 bushels, and of the white bearded Democrat gave the same yield. * * *

Four mixtures were made of varieties which, in appearance and in description of other characteristics, seemed much alike. These mixtures were composed of equal parts of the following varieties:

(1) Velvet Chaff (Penquite), Lehigh, Hindustan, Tasmanian Red, Nigger, Diehl Mediterranean, Tuscan Island, Miami Valley, Longberry Wabash, Bearded Monarch, and Fairfield.

(2) Wyandot Red. Poole, Witter, Sheriff, Hicks, Fultz, Currell Prolific, Oregon, Longberry, and Early Ripe.

(3) Russian Red, Improved Rice, Extra Early Oakley, and Crate.

(4) Deitz, Lebanon, and Theiss.

In each case the yield of grain per acre from the mixture was greater [by at least two bushels per acre] than the average yield from the varieties composing it, and in all but one case the pounds of straw and pounds per bushel were greater.

Wheat, effect of time and manner of harvesting (pp. 119, 120).—Tabulated data are given for experiments in which wheat was harvested June 18, 25, and 29, in 1891, and June 29 and July 4 and 13, in 1892, or when the kernels were in milk, in dough, and fully ripe.

Three cuttings, of nine samples each, were made for the years 1891 and 1892, each sample containing 200 spikes. The heads were removed from three samples of each cutting, and both straw and heads were placed in the drying room. Three were stood up in the drying room and three were put out in the sun till thoroughly dry. Each sample was threshed and the weights of straw and chaff, of grain, and of a certain number of kernels were ascertained. * * * In each of the two years the average yield of grain and weight of 1,000 kernels is greatest for that dried in the shade with heads on, which indicates that there is a transition of matter from straw to grain after cutting if the heads are not removed and the drying is not too rapid. In general there is an increase in yield from the earliest to the latest cutting. These results correspond with those obtained from experiments of like character in two previous years.

Wheat, oats, barley, rye, sugar beets, sorghum, and cañaigre, A. E. BLOUNT (*New Mexico Sta. Bul. No. 8, Nov., 1892, pp. 36*).—Tabulated and descriptive notes on tests of 480 varieties of wheat, 70 of oats, 42 of barley, 5 of rye, 10 of sorghum, and 3 of sugar beets. These crops were grown with irrigation. Thin seeding of grain has been shown to be best in the arid climate of New Mexico. Wheat growing seems to have been neglected in the Territory, but the experiments at the station indicate that this crop can be successfully grown there. African and some Asiatic varieties of wheat seem to be well adapted to this region, while the Mediterranean varieties do not do well. Oats gave large yields of grain and straw. Barley was grown with great success, maturing early enough to permit the raising of corn or beans as a second crop the same season. The sugar beets analyzed showed a high average percentage of sugar. The station has begun experiments in the cultivation of cañaigre.

Night vs. day irrigation for wheat, J. W. SANBORN (*Utah Sta. Bul. No. 21, Mar., 1893, pp. 12-14*).—Tables show the yields during three years of wheat (grain and straw) from two plats (during each season) of poor soil, 244 square rods in size, one of which was irrigated three times during the growing season at 10 a. m., and the other the same

number of times at sunset, the plat receiving night irrigation one season being irrigated during the day the following season.

The total yield (grain and straw) was about 15 per cent larger on the plats irrigated at night than on those irrigated during the day. The proportion of grain to straw was slightly greater on the plats irrigated in the daytime, "due probably to checking the growth of foliage" by the lower temperature which was found (data not reported) to prevail on the plats irrigated during the day. The weights of straw per bushel were: Plats irrigated at night, 120 pounds; irrigated during the day, 89 pounds.

Crop report for 1892, A. A. JOHNSON and F. J. NISWANDER (*Wyoming Sta. Bul. No. 11, Feb., 1893, pp. 22*).—Brief accounts of preliminary experiments at the experiment farms at Laramie, Lander, Saratoga, Sheridan, Sundance, and Wheatland with wheat, rye, barley, oats, buckwheat, flax, corn, root crops, and forage plants. These tests are made with a view to determining the agricultural capabilities of this new region.

Yield of staple crops, C. L. NEWMAN (*Arkansas Sta. Bul. No. 22, Dec., 1892, p. 72*).—The yields at the Pine Bluff Substation of corn, teosinte, sorghum, peas, Johnson grass, German millet, and sweet potatoes are tabulated.

HORTICULTURE.

A. C. TRUE, *Editor.*

The behavior of some eggplant crosses, L. H. BAILEY (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 338–345, figs. 4*).—"In 1889 three crosses were made among eggplants, one cross being between Round White and Black Pekin, one between Giant Round Purple and White Chinese, and the other between Long White and Black Pekin. In every case the parents were very unlike, both in shape and color of fruit and in color of plant. A number of plants were grown from the seeds of the crossed fruits in 1890, and the characters of the resulting offspring were fully explained and figured in Bulletin No. 26 of the station [E. S. R., vol. II, p. 737]. The present report deals with the second generation, grown in 1891." Details are given in descriptive and tabulated notes.

The cross which we called A was made between Round White and Black Pekin. The Round White is a small green plant which bears small, oblong, clear white, hard fruits. The Black Pekin is a large, dark purple plant which produces very large, nearly globular and very dark purple fruits. One fruit was obtained in 1889 as a result of crossing these two varieties. The seeds of this fruit gave in 1890 a series of plants which were almost exactly intermediate between the parents in size and other characters. The young shoots were much like the pistillate parent—Round White—but as they became older, the upper surface of the stems, the petioles and the veins of the leaves assumed the purple tinge of the male parent. In form and size, the larger part of the fruits seemed to vary in the direction of the pistillate

parent, many of them being decidedly ovoid in form and very small. A few were larger and had somewhat the form of the staminate parent. Frequently the same plant would produce mature fruits 2 inches and others 5 inches in diameter. In color the fruits were purple while young—first month or so—usually dark purple with lighter apex. In some instances this color was retained till time of edible maturity; but as a rule, the dark purple changed to a dull greenish hue, and the light apex became metallic gray with a faint tinge of purple and streaks of grayish-purple extended towards the base. * * *

From the first brood of this cross, 1890, eight fruits were selected or again crossed, as parents for succeeding crops. These fruits were essentially alike in color and shape. These eight fruits which were the parents of the plants discussed below, were as follows: (A1) Pollinated with another flower on the same plant; (A2) pollinated by Round White (original pistillate parent); (A3) pollinated by Black Pekin (original staminate parent); (A4) same as A3; (A5) pollinated with another flower on same plant, as in A1; (A6) same as A5; (A7) pollinated by Round White, as in A2; and (A8) selection not artificially pollinated.

From these eight fruits, 1,405 plants were grown at Cornell in 1891. * * *

As a whole, 513 of the 1,405 plants produced perfectly green foliage, showing the effect of the Round White. Most of the fruits produced by these eight samples were of an indifferent and ill-defined color, and were utterly worthless for market. In productiveness, the purple herbage plants were ahead of the green ones, although the green parent—Round White—is more productive than the Black Pekin. Of the 729 plants which gave sizable fruits before frost, 454 were purple and 275 green. In habit the A crosses were also very various. The Round White seemed to exert a great influence upon the stature of the plants, but the purple color of Black Pekin appeared to be more potent than the green of the other.

Series B came from a cross of Giant Round Purple and White Chinese. The former has purple herbage and a very large purple fruit, while the latter has green herbage and a long club-shaped white fruit. So far as beauty of form and color is concerned, this series was by far the most promising of the three crosses. The plants in this series, as in the former, were as a rule intermediate between the parents. Much of the vigor of the pistillate parent was transmitted to the offspring, but the leaves were smaller and less distinctly lobed.

In form the fruits, as a rule, resembled the staminate parent—White Chinese—but they were of greater diameter. The color at edible maturity was rich dark purple, with lighter apex. When fully mature, that is, when left for the seed to ripen, the light purple apex became gray, then yellowish like the staminate parent, while the dark purple body of the fruit became dull green. * * * Eight of these fruits grown in 1890 were selected or again crossed for planting in 1891. These B lots originated as follows: (B1) Pollinated by Giant Purple (original pistillate parent); (B2) pollinated with another flower on the same plant; (B3) pollinated by Giant Purple, as in B1; (B4) pollinated with another flower on same plant as B2; (B5) pollinated by Giant Purple, as in B1 and B3; and (B6), (B7), and (B8) selections not artificially pollinated. [The last three] were attractive fruits of a purple color and lighter apex, tending to be striped.

The offspring of these fruits—479 plants—showed a wide variation in color of herbage, many of them being green, although the greater part of them were purple. As a whole, however, these plants were comparatively uniform in size and habit, and could be distinguished from the A and C series at a considerable distance. The plants were low and bushy, but erect, mostly with a grayish-purple tinge when seen in mass. * * *

Series C originated from a cross of Long White by Black Pekin. This series, then, is much like A in parentage, except that the pistillate parent has longer fruit. The effect of the staminate parent in giving color to the foliage was more marked than in series A. In no case was there an absence of the purplish tinge of Black Pekin,

and frequently the color was nearly as deep as in the parent. The fruit was of intermediate color, but with the purple predominating. In form, a few of the fruits resembled the staminate parent; and many resembled the pistillate parent, while others were wholly distinct.

Four fruits were again crossed or selected in 1890 from this series: (C1) pollinated by another flower from same plant; (C3) pollinated by Black Pekin (original staminate parent); and (C4) selection, not artificially pollinated, * * * very angular at the ends, purple, with a metallic-gray apex.

In these lots the fruit pollinated from the same plant, C1, gave a variable and very unproductive offspring. C3, into which Black Pekin has gone twice, gave only purple fruits. C4 was the one which we particularly desired to fix, for the original fruit had strong points of merit. This fruit gave us 169 plants, none of which, however, were like the parent, and none seemed to possess superior merits. Only 31 of the plants from it produced fruits before the frost, and of these 5 had green herbage and 26 purple herbage. All the C plants were very tall in 1891, mostly dark in foliage, and late.

The result of all this experiment with secondary crosses and the second generation of primary crosses, numbering 2,126 plants, shows that they were exceedingly variable, that pollination from the same plant did not fix the types, that very few novel and promising types appeared, that the white and purple colors tend to unite to produce striped fruits, and that the greater part of the crop was unsalable because of the nondescript colors of the fruits. And all this only emphasizes the fact which we have learned with many other plants, that crossing for the purpose of producing marked novelties for propagation by seed is at least unsatisfactory.

Tomatoes, J. S. ROBINSON (*Maryland Sta. Bul. No. 19, Dec., 1892, pp. 8*).—Notes and tabulated data are given for 33 varieties tested in 1892. As regards earliness, the best results were obtained with Earliest of All, Table Queen, Paragon, Ignotum No. 10, Long Keeper, Michigan, Cumberland Red, and Favorite.

The largest yields were given by Baltimore Prize Taker, Cumberland Red, Chemin No. 5, Mitchell, Money Maker, Paragon, Perfection, Purple Queen, Red Queen, and Royal Red.

An experiment with different fertilizers for tomatoes is also reported. The results were undoubtedly materially affected by unfavorable weather. The largest yield was given by the plat on which dissolved boneblack was used alone, and the next largest where a complete fertilizer was applied.

Do fertilizers affect the quality of tomatoes? L. H. BAILEY (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 352–354*).—Tabulated analyses showing the percentages of solids, sugar, and acid in tomatoes from plats fertilized with nitrate of soda, muriate of potash, and boneblack, singly and in combination, stable manure, and no manure. The results show no uniform variation in the quality of the tomatoes, the differences between fruits on the same plat being as wide as between those on different plats.

Vegetable tests, L. R. TAFT, H. P. GLADDEN, and R. J. CORYELL (*Michigan Sta. Bul. No. 90, Feb., 1893, pp. 3–19*).—This is in continuation of Bulletin No. 79 of the station (E. S. R., vol. III, p. 609), and includes descriptive notes and tabulated data for old and new varieties of vegetables, as follows: Bush beans 59, pole beans 16, bush Lima beans

4, cabbages 28, sweet corn 31, cucumbers 16, lettuce 41, peas 55, peppers 8, squashes 4, and tomatoes 36. Among the newer varieties commended are the following: *Bush beans*—Butter Wax, Plymouth Rock, Shipper Favorite, and New Field Bean No. 6; *pole beans*—Golden Champion, Golden Cluster, Horticultural Lima, Old Homestead, White Lulu, and Giant Horticultural; *Lima beans*—Henderson Bush; *cabbages*—Burpee World Beater; *sweet corn*—First of All, Burlington Hybrid, and Country Gentleman; *cucumbers*—Goliath; *lettuce*—Colossal, Self-folding Cos, and Stubborn Head; *peas*—Budlong, Charmer, Stanley, Gladiator, and Heroine; *squashes*—Dunlap Marrow, Marblehead, and Sweet Nut.

Test of varieties of vegetables, E. S. RICHMAN (*Utah Sta. Bul. No. 20, Mar., 1893, pp. 15–28*).—Descriptive notes and tabulated data for 28 varieties of bush beans, 12 of pole beans, 14 of Lima beans, 35 of sweet corn, 12 of cucumbers, 20 of radishes, and 22 of beets. The varieties especially commended are: *Bush beans*—Speckled Wax; *Lima beans*—Henderson Bush; *sweet corn*—Cory, Maule XX, Everbearing, and Squantum; *cucumbers*—Boston Pickling, Early Cluster, Early Frame, and New Evergreen; *radishes*—Vick Scarlet Globe, Earliest White Turnip, White Strasburg, The 1834, and Celestial; *beets*—Landreth Very Early Forcing.

Varieties of cantaloupes, C. L. NEWMAN (*Arkansas Sta. Bul. No. 22, Dec., 1892, p. 67*).—Thirteen varieties of cantaloupes were tested. The Jenny Lind ripened first and Delmonico was the largest.

Grapes and apples, J. T. STINSON (*Arkansas Sta. Bul. No. 21, Dec., 1892, pp. 35–62, figs. 2*).—An account of spraying experiments in the station vineyard; notes on 15 varieties of grapes which did best in the vineyard in 1892; general directions for the location, planting, and care of a vineyard; methods of treating downy mildew and black rot; formulas for fungicides and insecticides; notes on spraying apparatus; tabulated summaries of reports from correspondents on the best varieties of apples and grapes, and the most prevalent fungus and insect pests in different parts of the State; and popular information regarding the nature and treatment of apple scab, codling moth, and plum curculio.

Fertilizers for grape cuttings, L. H. BAILEY (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 346, 347*).—A brief account of an experiment, during 1891 and 1892 on 10 plats of poor, gravelly soil, with 10,000 cuttings of Concord grapes planted 3 by 12 inches apart. Nitrate of soda, sulphate of ammonia, cotton-seed meal, cotton-hull ashes, muriate of potash, bone flour, superphosphate, and stable manure were each applied separately and compared with no manure. The fertilizers had no effect the first season, but during 1892 nitrate of soda produced the most vigorous growth of the vines, followed by sulphate of ammonia.

Substitutes for glass in greenhouse roofs, L. H. BAILEY (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 355, 356*).—Trials with

paper and oiled cloth indicate that they are unsatisfactory substitutes for glass in greenhouse roofs during the winter. "For summer or late spring use, oiled muslin is fairly satisfactory. Plants which require a heavy shade in summer can be grown to advantage under such a roof. In the summer of 1891 we found a cloth-roofed house to be an excellent place for flowering the tuberous begonias."

FORESTRY.

Forestry report, J. C. WHITTEN (*South Dakota Sta. Bul. No. 32, Dec., 1892, pp. 15*.—A report on the forestry experiments conducted since 1889. Thirty-two plats, 10 in 1889, 11 in 1890, and 11 in 1891, have been planted with 24 species of forest trees. The trees planted were: *Populus certinensis*, *P. pyramidalis*, *P. nolester*, silver maple, green ash, box elder, black cherry, yellow birch, white birch, white elm, white ash, soft maple, cottonwood, Scotch pine, white pine, black walnut, white walnut, *Salix fragilis*, white oak, European larch, Black Hills spruce, maple, hickory, and white spruce.

The average annual growth in inches made by those surviving the four seasons from 1889 to 1892 was as follows:

	Inches.		Inches.
Populus certinensis	30¼	*Salix fragilis*	24½
Populus nolester	30	Scotch pine	6¾
Populus pyramidalis	29	Larch	13
Black walnut	7¾	Cottonwood	31½
Yellow birch	21½	White ash	19½
White oak	6¼	Box elder (1 year old when planted)	23¾
White birch	18½	Box elder (2 years old when planted)	31
White elm	23½	Wild cherry	20
Soft maple	24¼		

The maximum growth, 80 inches in one season, was made by *Populus nolester*, the minimum, ½ inch, by white pine.

A meteorological table for the four years is given, by which, to some extent, the ability of each variety to withstand the climate is indicated. The total rainfall from April to November, inclusive, for the four years was: 1889, 10.783 inches; 1890, 16.402 inches; 1891, 12.10 inches; and for 1892, 22.73 inches.

A detailed account is given of the growth and present condition of the following species of trees: Black Hills spruce, Scotch pine, box elder, the poplars, European larch, yellow and white birch, oak, white elm, ash, walnuts, and soft maple.

WEEDS.

WALTER H. EVANS, *Editor.*

Golden-rod weeds, A. N. PRENTISS (*New York Cornell Sta. Bul. 49, Dec., 1892, pp. 303–305*).—A general statement concerning the distribution and habits of the species of the genus *Solidago*. Of the 24 or

25 species indigenous to the State, but 4 deserve, in the author's opinion, to be ranked as weeds. These are *Solidago nemoralis*, *S. rugosa*, *S. canadensis*, and *S. lanceolata*. Brief descriptions of these species, with suggestions for their repression, are given.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Note on the Cercospora of celery blight, G. F. ATKINSON (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 314–316*, fig. 1).—The author calls attention to the confusion which exists concerning certain morphological characters of the fungus.

The description as given by Saccardo represents the form developed under normal conditions, the hyphæ measuring 40–60 by 4–5μ, and the conidia 50–80 by 4μ and the form of the conidia being given as obclavate. The author finds that wet weather is conducive to greater growth of hyphæ and conidia, measurements of 50–150 by 4–5μ for the hyphæ, and 50–280 by 4–5μ for the conidia being observed.

Attention is called to a scar on the basal end of the conidia and corresponding scars on the hyphæ, showing the place of their former attachment. In the Report of the U. S. Department of Agriculture for 1886, p. 117, the distribution of this fungus is mentioned and the accompanying figure represents the conidia as clavate, attached by their smaller end. In Special Bulletin Q of the New Jersey Stations (E. S. R., vol. III, p. 884), the conidia are spoken of as "club-shaped," probably without reference to their attachment. The author shows by figures that they are obclavate, attached by their larger end.

Some diseases of cotton, G. F. ATKINSON (*Alabama College Sta. Bul. No. 41, Dec., 1892, pp. 65, plate 1, figs. 25*).

Synopsis.—(1) General nature of cotton diseases; (2) yellow leaf blight or mosaic disease; (3) frenching; (4) damping off, or sore shin; (5) anthracnose; (6) shedding of bolls; (7) angular spot of cotton; (8) areolate mildew of cotton; (9) cotton leaf blight; (10) root gall.

The bulletin is introduced with a general discussion of some of the diseases affecting cotton, and of the confusion caused by the popular designation of nearly every disease as a "rust." The author discusses in a general way the various causes of diseases of cotton, the value and effect of fertilizers on the crop, the methods of cultivation, and the means of disseminating information regarding this crop and its diseases.

Yellow leaf blight or mosaic disease, (pp. 9–18).—This disease, of physiological origin, was discussed in Bulletin No. 36 of the station (E. S. R., vol. III, p. 844), and the conclusions there given are confirmed by the investigations of the season of 1892. As stated in the previous bulletin, this disease is due to imperfect nutrition or assimilation,

The weakened condition of the plant makes it susceptible to several semi-parasitic fungi, the most important of which are *Macrosporium nigricantium* and *Cercospora gossypina* or *Sphærella gossypina*. These fungi hasten the destruction of their host, though they can not be considered as a cause, but rather a result of the disease.

A series of experiments to test the value of fertilizers was continued at the station farm and at Hope Hull, Alabama, during 1892. Kainit salt, and muriate of potash were tested, and the author considers the usefulness of kainit as a specific for this disease fully established. A description of the fungi associated with this disease is given, together with illustrations.

Frenching (pp. 19–29).—This disease was first noticed June 16, 1891, has since been observed at several stations in Alabama, as well as at Pine Bluff, Arkansas, and is probably of wide distribution.

"Beginning with the lower leaves, the first sign of the disease is a light yellowing of the leaf at the edge, or more commonly between the forks of the main ribs of the leaf. This yellow color is sometimes very pale and almost white. It is followed by a drying of the same parts of the leaf, and later, as these parts of the leaf die, they turn brown and become ragged, the leaf eventually falling to the ground. These different colors follow successively, and when the disease is well advanced all the colors are seen on the same leaf, the yellow color, of course, being near the still green portion of the leaf along either side of the main ribs. Gradually the disease advances into other leaves, until nearly all are affected, when the lower ones begin to fall. At last the uppermost leaves are affected and fall away."

The early investigations were all made on plants about coming into bloom. Subsequently very young plants were seen to be affected even before the plumule was well developed, the peculiar color being easily noticed on the cotyledons of the plant. Young plants may be affected and for a time seem to overcome the disease, but they will usually succumb later in the season. As a final test, breaking or cutting the stem will determine whether or not the plant is "frenching." If it be affected, the fibrovascular system will be found discolored, being more or less brown, depending upon the stage and ravages of the disease. In the discolored parts is found a fungus, apparently new, to which the author gives the name *Fusarium vasinfectum*. Pure cultures of the fungus have been obtained and inoculations made in apparently healthy plants, causing them to become diseased.

The parasite enters the plant near the surface of the ground or in the upper parts of the roots. The threads then as they increase grow upwards, and reaching the branches and petioles of the leaves grow out into their circulatory channels. This explains why the lower leaves are the first to be affected during the first period of the disease.

During the early stages the parasite is not in the leaves, the color changes and dying of the leaf being the result of a failure in nutrition due to the withdrawal of nourishment from the vascular channels of the stem by the parasite. * * * It

will be noticed that the failure of nutrition in the leaves is somewhat similar to that which occurs in the mosaic disease, but in "frenching" the interference with nutrition is so much greater than in the mosaic disease that the yellow color does not first appear in the smaller areas bounded by the smaller anastomosing veinlets, but extends rapidly up from the edge of the leaf between the larger veins.

The plants sometimes put out new growth and seem to recover, to a certain degree, from the disease. In many cases the upper part of the plant dies, the new growth coming from the latent buds and dwarfed branches near the ground. Many of the plants die outright.

Under favorable circumstances a new growth from the lower branches may entirely hide the dead top of the plant unless careful observation is made. In other cases the new growth may come from all parts of the plant. After a period of convalescence the plant may suffer a relapse. The second attack often differs materially from the first in external appearance, probably from the fact that the mycelium of the fungus is so well distributed throughout all parts of the plant that its effect in attacking the new growth and increasing in the old is more rapid, thus not permitting the gradual sequence of color observed when the fungus has but one opening through which it can enter the growing parts of the plant.

A few leaves sometimes show the characteristic sequence of color, but the leaf soon wilts, thus checking the color changes. Plants may pass through several periods of convalescence and relapse during a season. The fruit, even on plants that do not seem to be very badly affected, may frequently decay when nearly ready to open.

The disease, when not complicated with other diseases of the roots, does not advance with such rapidity into the roots, and this probably explains why so many plants sometimes recover; the roots in favorable weather sometimes supplying constantly the necessary moisture and nutrition, furnish material for the growth of the latent branches near the base. In sandy land the progress of the disease seems to be much more rapid, especially when the plant has attained considerable size and the fungus is already well distributed throughout the system. It then often happens that very few of the leaves show the gradual changes described above, but suddenly wilt on a hot or dry day; a few on one day, more on the following, or sometimes perhaps all on the same day. The plant then soon dies.

The author has found the same fungus on plants of okra, but so far no other plant seems to be affected by it. Diseased plants are often found the roots of which are affected by nematodes, and sometimes bacteria are associated with the fungus considered by the author as the cause of the disease. The soil in which the plant grows seems to have nothing to do with the disease, the popular idea that it is confined to certain soils being erroneous. No remedies for this disease are suggested.

Sore shin, damping-off, or seedling rot (pp. 30–39).—This disease of young cotton plants is identical in external appearance with the disease known as damping-off in this country and Europe, which is attributed to *Pythium de baryanum*. An examination of specimens failed to reveal that fungus, but others were present, among which were *Rhizopus nigricans*, a *Fusarium*, and an unknown non-fruiting fungus. Cultures of these were secured and inoculations made to determine which was the cause of the disease, and by a series of experiments it was determined that the unknown fungus was the cause. It is not difficult to isolate and will grow in almost any medium. It is described by the author as follows; "The threads are 9–11μ in diameter and the cells

100-200μ in length. At first they are colorless and possess numerous vacuoles of varying size in the nearly homogeneous protoplasm. As they age they become brown in color. The branches extend obliquely from the parent thread, are somewhat narrower at their point of origin, and possess a septum usually 15–20μ from the parent thread, giving a clavate form to this part of the branch which is continuous with the parent cell. Frequently the hyphæ are associated in strands, being woven or twisted together."

In nearly every culture medium the growth of the fungus was very rapid and in several sclerotia of varying size were developed.

No means are suggested for the repression of the disease.

Anthracnose (pp. 40–49).—This disease, mention of which is made in Journal of Mycology, vol. VI, pp. 100 and 173 (E. S. R., vol. II, pp. 455 and 749), and Bulletin No. 27 of the station (E. S. R., vol. III, p. 7), affects the stem, leaf, and boll, causing at times serious loss. It is caused by a fungus, *Colletotrichum gossypii*, and seems to be of wide distribution.

The stem does not show any characteristic injury when affected by this disease. The fungus is most often found at points of injury on the stem, as at the scars of fallen leaves. It sometimes attacks seedling plants at the surface of the ground, causing them to die much as if they were affected with the damping-off fungus, but the characteristic depression or well-defined ulcer of that disease is wanting.

The anthracnose is frequently found on the leaves, especially on sickly ones, but the author considers its presence here due largely to the semi-saprophytic habit of the fungus.

On the cotyledons, there is a characteristic injury. "The fungus attacks the edges of the cotyledons and destroys an irregular area bordering the middle portion. The diseased area is marked by the bright pink or roseate tint so characteristic on the fruit."

The fruit seems the part most attacked by the fungus, and such bolls can not mature good lint. The fungus causes a premature ripening of the tissues, so that they deaden and dry into fixed forms. The natural separation of the carpels is prevented and the boll remains closed or partially open, but firmly holding the lint.

The disease on the bolls originates in minute spots. These spots when very small are of a dull reddish-brown color, and present minute shallow depressions of the surface tissue. As these spots enlarge the tissue blackens until the development of the spores begins. These are developed in pustules, usually confluent, in the center of the nearly circular spot. Their development changes the color of the spot, which becomes a dirty gray if there are few spores, or a bright pink if the spores are numerous. Where the spores are few in number many of them stand out upon the surface on threads which have grown up through the tissue. The spores being colorless give a grayish cast to the dark back ground of diseased tissue.

When the spores are developed in great quantities they are piled up into a considerable heap, and form a large confluent mass occupying the central portion of the spot. A pink pigment, given off by the spores, is produced here in such quantity by the mass of spores that it can be readily seen. It is this pigment which gives the pink color to the spots.

While the disease is progressing and the spots are increasing in size, the bands of color in the tissue move out centrifugally. The outer band, which is the border of the spot, is dull reddish-brown in color, and its outer limits are frequently ill defined. Inside of this border is a blackish band of tissue which borders the pink center. As the spots increase in size they coalesce and frequently unite in forming a large diseased irregular area, covering sometimes one half the surface of the boll. * * * Sometimes the spots are not distinct, nearly the entire tissue being involved at an early period, so that the boll dies before a profuse development of the spores at any given point takes place. In such cases the boll appears nearly black, partly from the dead tissue and partly from the numerous black hyphæ and sclerotia of the fungus.

Inoculations and cultures were made with the fungus, and it was found that the cotyledons were especially susceptible to its attack. There is not sufficient evidence to show that the fungus travels through the plant from cotyledons to the leaves and bolls, nor is it known that the fungus does not remain in the soil, but the author thinks from the analogy of some of the smuts and of *Cystopus candidus* that scalding the seed before planting would secure at least partial immunity.

Shedding of bolls (pp. 50–53).—This condition has long been known and variously accounted for as caused by some Hemipterous insect, the bollworm, etc., but the author considers it due to physiological causes. The worst attacks are noticed during extreme dry or wet weather, or during the change from one of these conditions to the other. The normal growth is so interfered with as to influence the nutrition of the plant, and this finds expression in the shriveled dead bolls. Usually a sharply defined line separates the living and dead tissues. The falling away of the bolls frequently is very beneficial to the remaining crop, but in some of the cluster varieties the bolls do not separate from the pedicel. In this case much injury is often done by causing the adjacent bolls to rot.

Angular spot of cotton (pp. 54, 55).—This disease receives its name from the dark-colored angular spots on the leaves. It is apparently of bacterial origin, although inoculations from pure cultures have failed to produce the disease. It is most prevalent on leaves weakened by frost or inclement weather.

Areolate mildew of cotton (pp. 55–58).—This disease is so named on account of the definite small areas of the leaf which are affected. They are limited by the small veins and give a mildewed or frosty appearance to the affected places. It has been noticed in several places in the cotton belt, but has not as yet produced any serious injury. The disease is caused by a fungus, *Ramularia areola*, described as follows:

Spots amphigenous, pale at first, becoming darker in age, 1 mm. to 10 mm. (mostly 3 mm. to 4 mm.), angular, irregular in shape, limited by the veins of the leaf, conidia in profusion giving a frosted appearance to the spots. Hyphæ amphigenous, fasciculate, in small clusters distributed over the spots, subnodose, older ones frequently branched below, more rarely above. Where they are toothed the teeth are frequently unilateral when the hyphæ are curved instead of zigzag, several times septate, stouter below, hyaline, 25–75μ by 45–7μ. Conidia oblong, usually abruptly pointed, at the ends, sometimes concatenate in the early development of the hyphæ, hyaline 14–30μ by 4–5μ.

Cotton leaf blight (pp. 58–61).—This disease is caused by a fungus, *Sphærella gossypina.* Usually the older leaves, or often in wet situations all the leaves, are attacked. It is frequently associated with the yellow leaf blight, when by physiological causes the plant has become weakened. The presence of the disease is indicated by small red spots of irregular outline which increase centrifugally. Later the centers become light brown or dirty white, only the border showing the red color. Often the dead tissue falls away, leaving numerous holes in the leaves. The author shows that this is the perfect stage of a fungus, the conidial phase of which is known as *Cercospora gossypina.*

Root galls of cotton (pp. 61–65).—A semi-popular discussion of the disease of cotton caused by nematodes or eel worms. A more complete account of the life history of these worms may be found in Bulletin No. 9 of the station (E. S. R., vol. I, p. 185.) The information in the present bulletin appears to be largely compiled from the earlier one.

Diseases of the cranberry, E. S. GOFF (*Wisconsin Sta. Bul. No. 35, Apr., 1893, pp. 15–17, figs. 2*).—Compiled notes on cranberry galls and scald, from Bulletin No. 64 of the New Jersey Stations (E. S. R., vol. I, p. 263).

Can peach rot be controlled by spraying? F. D. CHESTER (*Delaware Sta. Bul. No. 19, Dec., 1892, pp. 16, fig. 1.*)—A preliminary report on experiments in three orchards during 1892, to discover a remedy for peach rot, in continuation of those reported in Bulletin No. 15 of the station (E. S. R., vol. IV, p. 167).

In the first orchard the fungicides used were: (*a*) Ammoniacal solution of copper carbonate—5 ounces copper carbonate, 3 pints ammonia, and 45 gallons water; (*b*) ammoniacal solution of copper carbonate—8 ounces copper carbonate, 1 pound ammonium carbonate, and 45 gallons water; (*c*) copper carbonate in suspension—1 pound copper carbonate and 25 gallons water; (*d*) neutral Bordeaux mixture—4 pounds copper sulphate dissolved in hot water; add milk of lime until litmus paper is turned blue, and dilute with water to 25 gallons. Six applications of the fungicide were given the trees between April 29 and July 2. After the third spraying considerable injury to the leaves was noticed; the least, however, on those on which Bordeaux mixture had been used. The fruit was picked and sorted into two lots, perfectly sound and more or less decayed, after which each lot was weighed. The amount of injury to each lot may be expressed as follows:

Fungicide used.	Percentage of decayed fruit.
Ammoniacal solution (*a*)	19.68
Ammoniacal solution (*b*)	13.00
Copper carbonate in suspension	13.92
Neutral Bordeaux mixture	17.99
Check (not sprayed)	32.70

In the other orchards only the ammoniacal copper carbonate, containing carbonate of ammonia, was used. Three sprayings were given, with the following per cents of decayed fruit: Orchard No. 2, sprayed 13.48, check 39.39; orchard No. 3, sprayed 10.62, check 17.56.

In these experiments the leaves were injured, there being but one third or one fourth the normal amount of leaves after the third spraying.

A meteorological table is given showing that the spread of the fungus was concurrent with wet weather and high temperature.

The author is inclined to answer his query in the affirmative if the following conditions be observed:

(1) Remove all mummified fruit, not permitting it to remain on the trees over winter.

(2) Spray before buds swell in the spring with 1 pound copper sulphate to 25 gallons water.

(3) As soon as buds begin to swell, spray with either solution *b*, *c*, or *d*, following this by another spraying just before they open.

(4) Give a third application when the fruit is about full size. Follow with two or three applications about a week apart until fruit is ripe. Heavy rain followed by warm weather will cause rapid rotting; hence due regard should be given this point in regulating time of spraying.

The black knot of plum and cherry, L. H. BAILEY (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 347–350, fig. 1*).—A popular description of this disease, with directions for its repression. The full text of the New York law on black knot is given. By the terms of the law any tree affected is declared a public nuisance and must be destroyed by fire. A board of three commissioners is to be created in any city or town upon application of the freeholders, the commissioners to be fruit growers. Their duties are to institute investigations in the region over which they have jurisdiction, and to condemn any affected tree or part of tree. Any one failing to comply with their orders to destroy diseased trees is liable to a fine of $25, or to ten days' imprisonment, or both.

A new anthracnose of privet, G. F. ATKINSON (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 306–314, plate 1, figs. 4*.—An account of a disease of privet (*Ligustrum vulgare*) due to the presence of a new species of anthracnose, *Glœosporium cingulatum*, Atkinson. The author characterizes the disease as follows:

A few twigs of privet having the appearance of blight were sent to me by Prof. Bailey. From 12 to 18 inches or more of the terminal portion of some of the twigs was dead, the point where the dead portion joined the healthy presenting the depressed line observable on twigs of pear and apple affected by blight. The resemblance to the blight, however, was only superficial and confined to twigs in the final stage of the disease. Other twigs presenting an apparently healthy terminal portion were found to be diseased at a point about 12 to 18 inches from the end, where a depressed area of diseased tissue was observed, oblong in outline, the longer diameter being parallel with the longitudinal axis of the stem. A comparison of the different specimens showed that this diseased area, quite small primarily, and seated

only upon one side of the twig, gradually increased in size until it eventually extended around the twig, completely girdling it. Seated in the original diseased areas, whether extending partly or entirely around the stem, are minute black elevated points, which can be seen with the unaided eye. These black elevated points are centers where pustules of the fungus are developed containing the spores.

For experimental purposes pure cultures of the fungus were obtained by the following method, devised by Koch: Three glass tubes containing a small quantity of liquid nutrient agar-agar were placed in a water bath at 43° C. Thin shavings through the fungus pustules on the stem were transferred to one of the tubes. This was shaken to distribute the spores, and then a portion of the liquid transferred to a second tube, and afterwards to a third tube.

The contents of the three tubes were poured into Petrie dishes and left to cool. In a few days the colonies had grown so as to be visible to the naked eye. The pure colonies of the desired fungus resembled snowflakes. From these colonies isolated germs could be obtained for pure cultures of the fungus.

In addition to the cultures in agar-agar, the fungus was successfully grown upon sterilized bean stems. In the cultures on the bean the close relationship is apparent between this fungus and the *Glœosporium fructigenum* of the apple. The points of difference characterize this as a hitherto undescribed species, for which the author proposes the name *Glœosporium cingulatum* or girdling anthracnose. The new species is described as follows:

Affected areas light brown, either oblong and on one side of the stem, or later completely girdling it. Acervuli 100 to 150 μ in diameter, rupturing the epidermis, in age black from the dark stroma lying in the base or extending irregularly up the sides, frequently forming a pseudo-pycnidium. Basidia numerous, crowded, simple, hyaline, or when very old perhaps fuliginous. Spores oblong or elliptical, straight or a little curved, usually pointed at the base, 10-20 by 5-7 μ when normal, often greatly exceeding these dimensions in cultures, or, if crowded in the media, may be considerably smaller. On *Ligustrum vulgare.*

Diseases of plants, with remedial measures, W. B. ALWOOD (*Virginia Sta. Bul. No. 24, Jan., 1893, pp. 23–40*).—The diseases considered are those of the apple, cherry, plum, peach, pear, and grape, which are popularly described with suggestions for treatment.

The diseases of the apple—brown spot (*Phyllosticta pirina*), rust (*Gymnosporangium macropus*), scab (*Fusicladium dendriticum*), and bitter rot (*Glœosporium fructigenum*)—were popularly described by the author in Bulletin No. 17 of the station (E. S. R., vol. IV, p. 354).

The diseases of the cherry are brown rot (*Monilia fructigena*), and a brown leaf spot, which seems identical with the disease of the apple under that name.

The plum diseases are black knot (*Plowrightia morbosa*) and the shot-hole fungus (*Septoria cerasina*). The use of a weak Bordeaux mixture is recommended as a remedial agent for the latter.

The peach, in addition to the brown rot of the cherry and the shot-hole fungus plum, is affected by leaf curl (*Taphrina deformans*).

The most serious disease of the peach is the yellows. This disease is described, and digging out and burning of all affected stock advised. A law providing for the inspection and destruction of trees was prepared by the author, and with some modifications passed the State legislature. The modifications made the law inoperative on account of impossibility of execution.

The pear diseases are the bacterial blight and the leaf blight or cracking caused by the fungus *Entomosporium maculatum*.

The grape diseases are black rot (*Læstadia bidwellii*), anthracnose (*Sphaceloma ampelinum*), downy mildew (*Peronospora viticola*), and the powdery mildew (*Uncinula spiralis*), all of which are described, and treatment recommended by the author, in Bulletin No. 15 of the station (E. S. R., vol. IV, p. 55).

A chapter on fungicides gives formulas for preliminary washes for trees and vines, with directions for their application, also formulas and directions for a weak Bordeaux mixture, an ammoniacal copper carbonate solution, and a soda-copper carbonate solution. The author recommends the combination of an insecticide with Bordeaux mixture, at least for the earlier applications, as a protection against insect depredations. Spraying apparatus is described.

ENTOMOLOGY.

Insects injurious to cranberries, E. S. Goff (*Wisconsin Sta. Bul. No. 35, Apr., 1893, pp. 3–19, figs. 18*).—Compiled notes on the black-headed cranberry worm (*Rhopobota vacciniana*), yellow-headed cranberry worm (*Teras vacciniivorana*), cranberry fruit worm (*Acrobasis vaccinii*), tip worm (*Cecidomyia vaccinii*), and cranberry scale (*Aspidiotus* sp.). The information is taken very largely from Special Bulletin K of the New Jersey Stations (E. S. R., vol. II, p. 418).

Insects affecting the blackberry and raspberry, F. M. Webster (*Ohio Sta. Bul. No. 45, Dec., 1892, pp. 151–217, figs. 38*).—Original and compiled notes on the appearance, life history, habits, and treatment of the following species of insects:

Blackberry leaf miner (*Fenusa rubi*), *Blennocampa paupera*, dogwood sawfly (?), (*Harpiphorus varianus* ?), raspberry sawfly (*Selandria rubi*), raspberry rootgall (*Rhodites radicum*), seed-like blackberry gall (*Diastrophus cuscutæformis*), cynipid leaf gall, pithy gall of the blackberry (*Diastrophus nebulosus*), *Solenopsis fugax*, upholster bee (*Ceratina dupla*), comma butterfly (*Grapta comma*), raspberry root borer and blackberry crown borer (*Bembecia marginata*), hedgehog caterpillar (*Pyrrharctia isabella*), fall webworm (*Hyphantria cunea*), waved lagoa (*Lagoa crispata*), saddle-back caterpillar (*Empretia stimulea*), Red-humped apple-tree caterpillar (*Œdemasia concinna*), *Schizura ipomeæ*, unicorn prominent (*Schizura unicornis*), cecropia emperor caterpillar (*Attacus cecropia*), orange-striped oakworm (*Anisota senatoria*), California tent caterpillar

(*Clisiocampa californica*), caterpillars of dagger moths (*Acronycta spinigera, A. brumosa, A. xylineformis, A. oblinita*), black army worm (*Noctua fennica*), stalk borer and heart worm (*Hydræcia nitela*), pyramidal grapevine caterpillar (*Pyrophila pyramidoides*), *Scopelosoma sidus*, raspberry geometer (*Synchlora glancaria*), chain-dotted geometer (*Caterva catenaria*), raspberry plumemoth (*Oxyptilus tenuidactylus*), *Cacœcia rosana*, grape-berry moth (*Eudemis botrana*), raspberry leaf roller (*Exartema permundana*), budmoth (*Tmetocera ocellana*), leaf roller (*Phoxopteris* sp.), blackberry leaf miner (*Nepticula rubifoliella*), case-bearing blackberry leaf miner (*N. villosella*), *Sesia hemizonæ, Apatelodes torrefacta, Sericaria mori, Thyatira scripta, Loxotænia musculana, Prodenia lineatella*, stem gall midge of the blackberry (*Cecidomyia* sp.), blackberry midge (*Lasioptera farinosa*), raspberry cane maggot (*Anthomyia* sp.), 15-spotted lady beetle (*Mysia* (*Coccinella*) *15-punctata*), American raspberry beetle (*Byturus unicolor*), *Carpophilus brachypterus, Limonius auripilis*, raspberry gouty-gall beetle (*Agrilus ruficollis*), rose chafer (*Macrodactylus subspinosus*), *Anomala binotata*, Goldsmith beetle (*Cotalpa lanigera*), giant root borer (*Prionus laticollis*), raspberry and blackberry cane borer (*Oberea bimaculata*), *Chlamys plicata, Bassareus mammifer, Cryptocephalus binomis, C. venustus, C. quadruplex, Pachybrachys carbonarius, Tymnes tricolor, Paria 4-notata*, Southern corn rootworm (*Diabrotica 12-punctata*), *Chelymorpha argus, Rhynchites bicolor*, strawberry weevil (*Anthonomus signatus*), Rocky Mountain locust (*Melanoplus spretus*), meadow katydid (*Orchelimum glaberimum*), snowy tree cricket (*Œcanthus niveus*), wheat thrips (*Thrips tritici*), scurfy bark louse (*Chionaspis furfurus*), rose scale (*Diaspis rosæ*), *Pemphigus rubi, Aphis rubicola, Macrosiphum rubicola, Sepha rubifolii, Siphonophora rubi*, blackberry flea louse (*Psylla tripunctata*), 17-year cicada (*Cicada septendecim*), square spittle bug (*Aphrophora quadrangularis*), flea-like negro bug (*Corimelæna pulicaria*), *Euschistus variolarius, Cosmopepla carnifex*, tarnished plant bug (*Lygus pratensis*), and *Iulus impressus*.

The black peach aphis, M. V. Slingerland (*New York Cornell Sta. Bul. No. 49, Dec. 1892, pp. 325–331, figs. 2*).—Notes on the history, appearance, and treatment of *Aphis persicæ-niger*, which has recently been introduced into Niagara County, New York.

Garden webworms on sugar beets, L. Bruner (*Nebraska Sta. Bul. No. 24, Sept. 15, 1892, pp. 8, fig. 1*).—Two species of webworms have been injurious to beets in Nebraska during the present season. One of these, the common garden webworm (*Eurycreon rantalis*), is described and an account is given of its food habits and life history, with suggestions regarding treatment. The second species, which has been more injurious than the other, is simply mentioned as having been known to entomologists only as a moth.

Underground insect destroyers of the wheat plant, F. M. Webster (*Ohio Sta. Bul. No. 46, Dec. 1892, pp. 221–247, figs. 8*).—Historical accounts of observations on the wheat wireworm (*Agriotes mancus*),

white grub (*Lachnosterna fusca*), and several species of crane flies, with suggestions regarding means of repression and accounts of their natural enemies. In Bulletin No. 42 of the station (E. S. R., vol. III, p. 889) similar accounts are given of the insects which burrow into the stem of the wheat plant. The following popular summary is taken from the present bulletin:

Wireworms are the larvæ or grubs of snapping or click beetles, and breed especially in low, damp, cold soils, feeding on the roots of grass and probably other herbaceous plants. They probably require a little over three years to develop from the egg to the adult. No thoroughly practical method of destroying these worms has as yet been discovered. Their numbers may be reduced by fall plowing, and their haunts rendered unattractive by a rapid rotation of crops and by underdrainage. Where fields of corn are attacked and replanting is made necessary, it is best to plant the second time between the old rows, allowing the latter to stand as long as possible in order to hold the attention of the worms and keep them diverted from the latter plants.

White grubs are the offspring of the May beetles or June bugs. While the wireworms develop to adults in summer and live over winter in that stage, the white grubs pass the winter either as grubs or pupæ, and develop to adults in spring, otherwise the life history of the two is much the same. The eggs are laid in the ground, notably in grass lands, and hatch in about thirty days. The young work little injury the first year, but the next they ravage the fields most seriously. These grubs prefer the higher to the lower lands, and therefore drainage has much less effect upon them. Probably fall plowing and rapid rotation of crops are the best methods to pursue. Fertilizing with barnyard manure is a protection against damage in infested fields.

Crane flies are known also as gallinippers and many term them cutworm flies, though they have no connection with cutworms. There are a number of species of these, some of which are one and others two-brooded each year. The eggs are deposited in grass and clover lands, more particularly in low, flat, damp lands. The maggots feed on the roots, seldom appearing above ground except in very wet weather. The ravages of these larvæ can be prevented in wheat lands by plowing early in September. This measure will also preclude the probability of injury to corn the following year. For injuries on grass or clover lands no remedy or preventive is as yet known.

Insects and insecticides, W. B. ALWOOD (*Virginia Sta. Bul. No. 24, Jan., 1893, pp. 1–23*).—Popular descriptions, with suggestions regarding treatment, of the following insects: Plant lice, scale insects, canker worm, fall webworm, tent caterpillar, bag worm, rose chafer, codling moth, plum curculio, borers, potato beetles, striped cucumber beetle, flea beetles, cabbage worms, currant worm, corn worm, and tomato worm.

The nature and methods of preparation of the following insecticides are also given: Arsenites, white hellebore, kerosene emulsion, fish-oil soap, and pyrethrum powder.

Insecticides and their appliances, C. H. T. TOWNSEND (*New Mexico Sta. Bul. No. 9, Dec., 1892, pp. 25, plate 1, figs. 20*).—An account is given of the more common insecticides, and various forms of apparatus for their application are described and illustrated. The bulletin also contains the text of an act of the legislature of the Territory, approved

February 26, 1891, for the repression of insect pests. This act provides for the appointment of "horticultural commissioners" in each county, who shall have the power to inspect orchards, vineyards, etc., and to compel the owners to destroy injurious insects which may be found on their property. Local inspectors may be appointed to act under the direction of the commissioners.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor*.

Feeding ruminants on grain alone, J. W. SANBORN (*Utah Sta. Bul. No. 21, Mar., 1893, pp. 1-12*).—The experiments reported in this bulletin were made to ascertain whether ruminants could be successfully fattened on grain alone, and the effect of such feeding on the stomachs and other internal organs. An experiment commenced with a calf terminated abruptly from an accident. Two sheep were fed from January 16 to July 6 on grain with some turnips and beets. The kind of grain fed is not stated, except that it consisted of one fourth oats. The animals averaged 142 pounds in live weight at the beginning of the trial. Through mistake they were placed where they could secure a little grass by reaching through the fence, but the amount eaten is believed to have been very small. At the beginning of the trial, when the coarse food was discontinued, there was a decrease in the live weight, lasting about two months. This is believed to be due to the change in the contents of the stomach. The gain in weight from March 16, when the loss incident to the change of food had ceased, to the close of the trial, July 6, was 42 pounds. "The gain is fully as good as could be expected from a shoat receiving the amount of food eaten by the sheep."

These sheep were slaughtered July 6 that a study might be made of the weight of the stomach and other parts. The stomach, fat, and intestines of No. 1 weighed 19½ pounds; this sheep had pieces of hay in the first stomach and a trace of oat hulls. The stomach, fat, and intestines of sheep No. 2 weighed 10½ pounds; the contents of the large stomach weighed but 1½ pounds.

The stomach, intestines, and fat of 4 sheep used in other trials with coarse food, weighed nearly twice as much. These sheep were as fat or fatter than any that we have slaughtered and gave tender and well-flavored mutton.

In continuation of the study, a 2-year-old steer weighing 635 pounds was fed exclusively on grain from April 13 to December 2. The character of the grain fed is not stated.

During the opening period when the stomach contents were decreasing there was no gain, but a loss, as there was during the last month of feeding. From May 2 to October 24, or for 175 days or about six months, the gain was 326 pounds, or 1.86 pounds daily. This gain is the gain of flesh, and a good one.

The food eaten from May 2 to October 24 was 1,866 pounds; food eaten from May 2 to October 24 for a pound of gain, 5.7 pounds. Considering the weight of the steer, this gain is fully as good as that obtained from hogs. The food required for a pound of gain increases steadily with the weight of the animal fed.

These figures are compared with those observed by the author for pigs at different stages of growth, indicating that under favorable conditions a pound of beef can be made on grain alone as cheap or cheaper than a pound of pork.

Data secured at time of slaughtering, and the weights of food and water consumed and of excreta, are tabulated in full.

The large stomach contained mostly water and hulls of bran, yet this is food material. It was flat or not distended by food; indeed, it was not half full, and the material that it did contain had a very unusual proportion of water. Rumination by the steer was mostly suspended. It may be doubted whether the unfilled stomach can as readily return the food to the mouth. It is not improbable that the material that it contained had accumulated there, as it is not a stomach for direct digestion. The second stomach was not full, and the third was far from being as tense as is usual, and was much softer. It is probable that a few generations thus fed would have these stomachs much reduced in size, if not largely eliminated in actual use for the purposes now used. This would give a steer with less waste of body in slaughtering. Whether the conversion of cattle into non-ruminants is desirable at all is yet to appear. It would not be as a rule, but may be under exceptional conditions. This experiment makes it highly probable that the steer makes or may make as economic or a more economic use of food than the pig.

[A comparison of the data at slaughtering with that for other steers slaughtered at the station indicates that] "the blood of our steer weighed more, the lungs less, the liver less, and the spleen much more. This variation holds when compared with steers slaughtered here at other times and weighing more. The variation is very marked and interesting. * * * The steer was in good flesh, good health, and gave very nice, tender meat. To the eye the meat had a peculiar appearance. It was seemingly far more gristly than ordinary meat, while the fat was more solid, cutting very much harder with the knife than ordinary fat. * * *

The amount of water drank was very little, or only about one half that required by the steer when fed on hay. This fact in part accounts for the good showing made by the steer when fed on grain alone, in comparison with the pig.

The author summarizes the results and inferences from his experiments in the following terms:

(1) Cattle and sheep can be successfully fed on grain alone for very long periods.

(2) Cattle and sheep fed on grain alone make a pound of growth on as few or less pounds of grain than hogs do.

(3) Cattle when fed on grain drink but little water, void a larger ratio of it as urine, and probably vaporize less of it by the lungs than when receiving hay or coarse food.

(4) The stomachs of sheep and cattle weigh less when fed on grain, the first stomach notably so.

(5) The first stomach of sheep and cattle receives fine foods, but does not fill up, nor quite half fill. The animals practically cease ruminating when fed grain alone.

(6) The vital organs of a slaughtered steer weighed quite differently from those of cattle heretofore slaughtered, especially so in regard to blood, which weighed more, and more notably so for lungs, which weighed less, and is the first notable instance in the experience of the writer of the variation of lungs due to food.

(7) These relations of food to the development of vital organs should receive the careful attention of physiologists, notably in the relation of food to human health.

Residuary effect of a grain ration for cows at pasture, I. P. ROBERTS (*New York Cornell Sta. Bul. No. 49, Dec., 1892, pp. 322–324*).—Bulletin No. 36 of the station (E. S. R., vol. III, p. 613) contains an account of an experiment on a grain ration for 16 cows at pasture. As

there stated, the lot receiving grain averaged about 3½ pounds of milk more per cow daily than the lot on pasturage alone. For six months, beginning with the following April, the lot which the previous season had received grain averaged 480.2 pounds of milk per cow more than the lot which had received no grain. This represents a gain of a little more than 16 per cent in favor of the grain-fed lot. "It seems reasonable to assume that this increased production was due to the grain fed the preceding year, especially in the case of the younger animals. Indeed, it was plainly evident that the grain-fed 2-year-olds and 3-year-olds developed into better animals than their stable mates having no grain."

VETERINARY SCIENCE AND PRACTICE.

The corn-fodder disease, F. S. BILLINGS (*Nebraska Sta. Buls. Nos. 22 and 23, Oct., 1892, pp. 159, plates 11*).—This is an enlarged edition of a former publication (Nebraska Sta. Buls. Nos. 7, 8, 9, and 10; E. S. R., vol. I, p. 123), and deals with the disease formerly designated as the "cornstalk disease."

Among the subjects embraced in this publication are statistics on the prevalence and extent of the disease, an account of various outbreaks, inoculations, and feeding experiments with small animals.

Two pigs were fed on the lungs, heart, and other viscera from a calf which had died as the result of inoculation with a culture of the corn-fodder disease germ. One pig died; the other became ill, but recovered.

The author discusses at length "chronic broncho interstitial pneumonia in cattle as a sequel to the cornstalk disease. * * * The condition met with in the lungs of cattle resulting from the cornstalk disease, while often a chronic interstitial disturbance and somewhat resembling the lungs in contagious pleuro-pneumonia, is so markedly different and generally so washy and broken in outline, in comparison, that any competent veterinary pathologist should be able to recognize it at a glance. * * * This corn-fodder disease has nothing of a contagious character about it. It does not owe its primary origin to the presence of a diseased animal in the first place, or to any material from such a diseased animal among healthy stock. * * * It is an absolutely local disease."

In the same publication the author discusses a disease which prevails among cattle and horses in the hot months. He terms the disease a "summer septicæmia." An outbreak in Iowa in 1891 is discussed at length by Dr. T. D. Collins.

TECHNOLOGY.

Sirup and crude sugar making from sugar cane and sorghum, C. L. NEWMAN (*Arkansas Sta. Bul. No. 22, Dec., 1892, pp. 80–84*).—Directions for grinding the stalks and treating the juice are given, and notes on the apparatus necessary for sirup-making on a small scale.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Production and distribution of the principal agricultural products of the world (*Division of Statistics, Miscellaneous Report No. 5, Feb., 1893, pp. 205*).—Notes and tabulated data on the production and distribution of wheat, corn, rye, barley, oats, potatoes, tobacco, butter, cheese, cotton, wool, and flour in the different countries of the world.

There are ninety-two countries represented in this work and ten consecutive years, wherever annual statistics are available. The fluctuations of annual production, both in area and rate of yield and in trade requirements, are constantly confusing the minds of readers of agricultural statistics, being so wide and abrupt as to render the record of a single year in any country nearly useless for practical deduction. This fact enforces the necessity of a systematic average of a series of years, which with few exceptions has not heretofore been found in the statistical records of any country, and never has there been so comprehensive and complete a collection as to extent of geographical area represented and continuity of annual statements.

The following general statements regarding different products are taken from the report:

Wheat.—[The average crop of the world is estimated to be about 2,281,000,000 bushels.] The wheat "market of the world," which is open for the surplus production of producing countries is circumscribed and very small when the general use of wheat as a bread grain is considered. Practically it is all in Europe, and even there limited to the necessities of a few countries. Insular and factory-studded Great Britain, with its small area and its teeming population, and populous little Belgium practically furnish the market for which the wheat growers of the world are striving in competition. Excluding these two countries, Europe is practically self-supporting, the excess in the eastern countries being sufficient to meet the deficiencies in the western nations. To supply the small amount required to meet the European deficiency, the fields of America, India, and Australasia are principally relied upon, and the sharp competition between the agriculturists of the rivals for the possession of this "world's market" results in furnishing a cheap food supply for the artisans of the manufacturing nations.

Corn.—[The average crop of the world is about 2,300,000,000 bushels.]

The United States produces 80 per cent of the total crop, taking the average of a series of years, and a much larger proportion in years of heavy production. In 1891 the crop of this country almost equaled in volume the average crop of the world, and in such seasons the volume of the world's corn crop exceeds that of any other cereal. * * *

The average annual net importation of Europe, according to the data presented, is about 64,000,000 bushels. The average net exportation from the United States during the same period is about 57,000,000 bushels, of which Canada takes about

2,000,000 bushels. The remainder required comes from the average exportation of 9,000,000 bushels from Argentine Republic. In Europe only four countries appear as exporters—Bulgaria, Russia, Roumania, and Servia—and of these only Russia and Roumania are important. The former ships more than one half of her total crop and the latter nearly as large a proportion. The net contribution of the United States to meet the world's requirements is much larger than the net contributions from all other sources combined, and yet the shipments from this country amount to less than 4 per cent of the annual production.

Rye.—This cereal is one of the most important resources of European agriculture and is a prominent feature in the trade of nearly every country of that continent. In the rest of the world it is of minor importance only. In many of the countries of continental Europe it is the bread of the people, the production and consumption being greater than that of wheat. The largest crop of any country is grown in Russia, averaging more than 700,000,000 bushels, a cereal crop second to that of no country, except corn in the United States. Germany stands second in production, with a crop averaging 228,000,000 bushels, and Austria-Hungary third, with 122,000,000 bushels.

In the case of this grain the centers of production and consumption are the same, and hence it does not figure in foreign trade proportionate to its importance as a crop. The largest importing country, Germany, purchases only 30,000,000 bushels per annum, and the heaviest exporting country, Russia, ships only 46,000,000 bushels. This does not include the trade in rye flour. The continent practically supplies its own wants, the aggregate imports, as presented below, amounting to about 67,400,000 bushels and the exports 66,500,000 bushels.

Outside of Europe, the United States and Japan are the only countries in which the crop is important. In the United States the average production is about 25,000,000 bushels, the net exportation about 2,000,000 bushels, leaving a supply for domestic requirements of about 23,000,000, or but little more than one third of a bushel for actual consumption for each unit of population. * * * The world's annual rye crop is 1,317,803,333 bushels.

Barley.—Barley is a prominent crop in Europe and Canada, an important one in Japan, and one of the minor cereal crops in the United States and in Australasia. Russia leads in production, followed by Germany, Austria-Hungary, and the United Kingdom in the order named. Only two of these four countries (Russia and Austria-Hungary), produce enough for their own requirements. * * *

Only four countries of the world produce a larger barley crop than the United States, and yet in this country it is classed as one of the minor cereals. The average production is about 55,000,000 bushels for a period of ten years, but in recent years it has been larger and is increasing. It is the only cereal which is not produced in sufficient quantity for the domestic requirements, the average net imports for ten years having amounted to about 10,000,000 bushels. [The world's crop is about 802,000,000 bushels.]

Oats.—The oats crop of the world is practically all grown in Europe and North America, although Australasia furnishes a considerable product for her own consumption. The United States leads the world in annual production, followed by Russia, Germany, and France in the order named. The bulk of the trade of the world is confined to exchanges among the countries of Europe, the foreign trade of other countries being comparatively small. [The world's crop is about 2,328,000,000 bushels.]

Potatoes.—This is the second contribution of the New World to the food supply of nations, and it has become an important resource in the dietary of nearly every country of the world where systematic agriculture is practiced. With other root crops it is an especially important item in European agriculture, forming in many districts the staple article of diet. The heavy yield per acre and its inherent value for food purposes make it available as a crop in countries where agricultural areas are lim-

ited and population dense. Under intensive farming methods the produce per acre of potatoes is very large. This is exemplified by the garden-like culture which is carried on in the Channel Islands, Jersey and Guernsey, where an area of only 8,819 acres furnished 2,336,783 bushels of potatoes for shipment to the United Kingdom in 1891. This is at the rate of 265 bushels per acre in addition to the home consumption, and the export trade amounted to $331 per acre cultivated. The value of the crop in densely peopled countries is appreciated, the supply per head being large where the population per square mile is greatest. In this particular Germany leads, with Belgium and Netherlands in the order named.

The crop does not enter largely into the foreign trade of any country, the production of each country being mainly for home use, and in most of them ample for domestic requirements.

Tobacco.—Trade in this product is reported in almost every country for which any records are extant. Its use in some form is almost universal, and in the more prominent countries it forms an important item in foreign trade. It is the third of America's contributions to agriculture, which has been accepted by those engaged in the cultivation of the soil wherever climatic conditions are favorable. With variations, the result of culture and differences in soil and climate, it is grown in almost every section of the world, its only limitations practically being the northern countries, where the season is not long enough to admit of proper growth. As far north as Sweden and as far south as the Argentine Republic part of the domestic consumption is supplied by domestic production. * * *

No country in Europe furnishes any considerable supply of tobacco beyond its own requirements and the annual net importation for that continent is almost 350,000,000 pounds. It is the great market for the surplus production of the world, and its demands are supplied by shipments from many sources. The United States furnishes the largest proportion, her net shipments averaging 230,000,000 pounds per annum. The rest is drawn from miscellaneous sources, the East and West Indies furnishing the bulk.

Butter.—The items of butter and cheese appear to more or less extent in the trade of almost every civilized country, but in the absence of any definite statements of domestic production it is not possible to present a showing of the net supply or the consumption per capita. Taking the continent of Europe as a whole, the production of butter is in excess of consumption, and there is an annual exportation from all the countries presented aggregating more than 75,000,000 pounds per annum. * * * In America the United States and Canada monopolize the shipments of butter, the trade of our northern neighbor being large, aggregating almost one half that of the United States.

Cheese.—Data of production of cheese are available for only a few countries, and then generally in fragmentary shape. It forms an important item in the food supply of many countries and figures extensively in international trade. It is especially important in the European dietary, in many districts being a substitute for meats. Europe, however, does not produce sufficient for her own requirements, the aggregate imports for the countries presented being about 303,000,000 pounds each year, against an aggregate exportation of about 173,000,000 pounds, leaving 130,000,000 pounds to be drawn each year from non-European sources. In addition to this deficiency, there is an excess of importation, small for each particular country, but large in the aggregate, in most of the other countries of the world, outside of North America, for which records are available. There are only two prominent sources of supply—the United States, with a net exportation of nearly 100,000,000 pounds each year, and Canada, with more than 70,000,000 pounds.

Cotton.—According to generally accepted estimates, the United States produces more than one half of all the cotton grown in the world, and about 75 per cent of the total amount which annually enters into civilized commerce. Outside of the United States and Japan there are no official data of production for any country prominent

as a source of supply. A very large portion of the annual crop is grown in countries about the resources of which but little is known.

[The annual crop of the world is from 12,000,000 to 15,000,000 bales.] * * *

The United States possesses natural advantages, which should make it the leading cotton-manufacturing, as it is the leading cotton-growing, country of the world. The raw product is produced at home, is available without the expense of long-distance transportation, while the inventive genius of our people insures the best machinery and methods. Our planters will continue to supply the demand of the Old World for the raw product, but it will be a secondary object, the demand for domestic consumption being first and more profitable. Cotton goods of American manufacture should be found in every market of the world, and especially should we monopolize this trade in our sister republics of North and South America.

Wool.—Data of production are fragmentary and available in any form for but few countries. No country in Europe is prominent as a source of supply beyond domestic requirements except Russia. Spain has a net exportation of about 10,000,000 pounds per annum, but the supply from other countries is generally small. * * * The total imports recorded for the countries of Europe average 1,419,000,000 pounds per annum, and the total exports 587,000,000 pounds, a net deficiency of about 832,000,000 pounds, which, with the deficiency of 90,000,000 pounds in the United States, makes the wool market of the world. More than one half of the exports of Europe are shipments from the United Kingdom representing the surplus production of her colonies, gathered in her enormous trade and reshipped to the consuming countries.

The wool to supply the demand for nearly 1,000,000,000 pounds referred to is drawn from various sources, mainly from countries where agricultural development is largely along the lines of pastoral industry. The Australasian colonies, Argentine Republic, the British Possessions in Asia and Africa, China, Uruguay, and some other out-of-the-way countries are the sources of supply of commercial wool.

A combination of official and commercial estimates makes the total product of the world at the present time about 2,500,000,000 pounds.

Flour.—The United States is the great source of flour supply, the exports of wheat flour from this country exceeding the net exports of flour of all kinds from all other surplus countries. Next in order of prominence are Austria-Hungary and Germany, but in the case of both of these countries the figures given are presumed to include flour of all kinds. The United Kingdom is the great market, with an average net importation of 1,660,000,000 pounds of wheat flour, equivalent, on the generally accepted basis, to about 38,000,000 bushels of grain. The net exports from the United States are somewhat larger, being equivalent in grain to about 42,000,000 bushels.

Rice: Its cultivation, production, and distribution in the United States and foreign countries, A. AUSTIN (*Division of Statistics, Miscellaneous Report No. 6, Jan., 1893, pp. 1–76*).—This report embraces the history of rice in America, and the statistics of its production in the several States and foreign countries; the systems of cultivating, harvesting, curing, and threshing; the yield and profit; the cultivation of upland rice; preparation of rice for the market; its food value, and the diseases and enemies of rice.

[In the United States] there are several varieties of lowland rice, the most appreciated being the gold seed, so called from the golden yellow color of its husk when ripe. Of this, again, there are two subvarieties or, more properly, two sizes. * * * The gold seed rice has almost entirely superseded the white rice * * * and is now the most important rice of American commerce. The famous Carolina rice is esteemed * * * as the best rice in the world.

[The cultivation of upland rice] is more simple than that of lowland rice, and requires less preliminary outlay. Any soil is suitable for upland rice that is suitable for cotton, but it prospers best upon level, sandy soil inclined to be moist, and it is said, upon such a soil, to yield 3 bushels of grain, where Indian corn from the same field yields but 1 bushel. Preparation for planting may be made in the same way as for cotton, * * * laying out in ridges. The drill furrows are made about 2 inches deep.

Upland rice is said to have been introduced into China during the tenth century. There are three varieties of it, precocious, mid-season, and late-growing or Manchooria rice. It is generally considered to have a more agreeable taste than the lowland rice, but is less productive. In general all Asiatic rice is of smaller grain than that grown in South Carolina, is not so white, and is of less excellent quality. The best Chinese rice is said to be that produced upon the plains of Kiang-Su. Upland rice [in China] is said to yield about 30 bushels of cleaned rice to an acre, * * * or 1,800 pounds of cleaned rice, equivalent to 3,200 pounds of paddy. * * *

[In Japan] great attention is given to the selection of seed. * * * Some parts of the rice head are of a very light yellow color, while other parts retain more of the color of the stalk, and it is these latter parts which are selected for seed * * * and assiduously preserved from all dampness which would impair their vitality. Seed should not be selected upon low, boggy land, nor upon land of extreme fertility, the best seed being found upon a medium grade of soil.

In Bengal * * * is the "aous" rice, which is grown upon high, light, sandy soils, not subject to irrigation, * * * and requiring from three to four months for ripening. In the Punjab * * * a celebrated upland variety, the Bara rice, is highly prized; * * * also the basmati rice, described as being of large, white, and fragrant grain.

In Nepaul the Joomla rice is extensively grown. This is an upland variety which, on account of its peculiarity of flourishing seemingly without inconvenience amid the snows and frosts of the Himalayas at an elevation of from 6,000 to 7,000 feet, botanists have named *Oryza nepalensis*.

Among the diseases and enemies of rice treated in this report are the "brusone," or rust, white blast, the water weevil (*Lissorhoptrus simplex*, Say), the rice grub (*Chalepus trachypygus*, Burm.), the rice-stalk borer (*Chilo plejadellus*, Trinck.), the rice bird (*Dolichonyx oryzivorus*), and the English sparrow (*Passer domesticus*).

Rice soils of South Carolina, M. WHITNEY (*Division of Statistics, Miscellaneous Report No. 6, Jan., 1893, pp. 77–89*).—The author calls attention to the fact that much land suitable for rice culture lies waste in South Carolina, and he enumerates the causes for this condition.

The soils of the rice lands are very rich alluvial deposits, brought down from the up-country and deposited along the low level terraces at high tide or when the water overflows its banks during the time of freshets. * * * The soil of the rice lands is a very strong clay, containing 20 to 50 per cent of organic matter, so thoroughly disintegrated as to have lost all of its original structure and existing as an amorphous or humus-like mass. In its usual moist or wet condition the soil can be cut with ease like butter or soft cheese, and a stick can be pushed down into it to a very considerable depth. * * * The rice lands are generally underlaid, at a depth of 4 to 6 feet, with an impervious layer of bog-iron ore. When there is insufficient air in the soil, as when the soil is saturated under a very shallow layer of water which has not been changed for some time, red, oily scum comes to the surface, as is often seen with stagnant water. This makes what are called "alum" spots by the laborers, and the plants are killed if there is much of it. It shows that there is an insufficient supply of air in the soil and a deoxidation of the iron compounds and of

the organic matter in the soil to provide oxygen for the oxidation of other matters. The remedy is to repeatedly ebb and flow the land with every tide, thus letting on successive quantities of fresh, aërated water. * * *

It is this insufficient supply of air in the soil which makes it difficult to get a stand of the finer grasses or of other crops on these very fertile rice lands. * * *

The rice lands must be plowed very shallow, as the subsoil is distinctly poisonous when any considerable amount is turned upon the soil, and it may take several years for the land to recover from a single deep plowing. * * *

A number of samples of typical rice soils were collected from the large plantations of Mr. R. J. Donaldson, of Georgetown, South Carolina, which are believed to represent fairly well the important types of rice land of that locality.

Mechanical analysis of rice lands.

[Air dry samples.]

Diameter.	Conventional names.	Big Cypress soil, 0-6 inches.	Cooter field soil, 0-6 inches.	Sob field soil, 0-6 inches.	Cooter field subsoil, 6-9 inches.	Sob field subsoil, 6-9 inches.
mm.						
2-1	Fine gravel	0.00	0.00	0.00	0.00	0.00
1-.5	Coarse sand	0.00	0.00	0.71	0.00	0.08
.5-.25	Medium sand	0.05	0.10	2.70	0.00	0.25
.25-.1	Fine sand	0.06	0.11	0.83	0.04	0.13
.1-.05	Very fine sand	2.56	1.03	0.37	3.50	0.15
.05-.01	Silt	26.38	19.65	10.32	21.12	13.97
.01-.005	Fine silt	8.43	10.83	5.32	12.95	8.10
.005-.0001	Clay	46.15	43.70	31.90	43.49	34.85
	Total mineral matter	83.63	75.42	52.15	81.10	57.53
	Organic matter, water, loss	16.37	24.58	47.85	18.90	42.47
		100.00	100.00	100.00	100.00	100.00
	Loss by direct ignition	18.68	24.32	47.36	17.22	39.65

Mechanical analysis of rice lands.

[Calculated on organic and water-free basis.]

Diameter.	Conventional names.	Big Cypress soil, 0-6 inches.	Cooter field soil, 0-6 inches.	Sob field soil, 0-6 inches.	Cooter field subsoil, 6-9 inches.	Sob field subsoil, 6-9 inches.
mm.						
2-1	Fine gravel	0.00	0.00	0.00	0.00	0.00
1-.5	Coarse sand	0.00	0.00	1.36	0.00	0.14
.5-.25	Medium sand	0.06	0.13	5.18	0.00	0.43
.25-.1	Fine sand	0.07	0.15	1.59	0.06	0.23
.1-.05	Very fine sand	3.05	1.36	0.71	4.32	0 26
.05-.01	Silt	31.55	26.05	19.79	26.04	24.30
.01-.005	Fine silt	10.05	14.36	10.20	15.97	14.09
.005-.0001	Clay	55.22	57.95	61.17	53.61	60.65
		100.00	100.00	100.00	100.00	100 00

Big Cypress field, "clay and alluvial mud."—This is considered the very finest type of rice land, and such soil as this can be cropped indefinitely without showing any effect of the continued cropping. * * *

Cooter field.—The soil is black and sticky and full of roots and stubble. The subsoil is a light yellow color. * * *

Sob field.—These lands are naturally poor, and are considered the very poorest kind of rice lands. They are exhausted in two or three years, and require rest to produce good crops. They respond readily to commercial fertilizers, and one year's rest with the deposit from the river in the continual ebb and flow of the tide gives splendid crops.

Upland rice soils.—For obvious reasons upland rice is preferably grown on low, wet spots, where neither cotton nor wheat could be successfully grown. These areas are usually underlaid with an impervious clay, or for some reason have insufficient drainage, and the soils are very constantly wet, although there is commonly no water standing over the surface. A limited supply of air favors the accumulation of a large amount of organic matter in the soil. The following table gives the mechanical analysis of a typical soil of this kind from Lenoir County, North Carolina:

Mechanical analysis of rice land (North Carolina).

Diameter.	Conventional names.	Air-dry samples.		Organic free basis.	
		0–6 inches.	6–12 inches.	0–6 inches.	6–12 inches.
mm.					
2–1	Fine gravel	0.00	0.05	0.00	0.08
1–.5	Coarse sand	0.39	0.31	0.52	0.50
.5–.25	Medium sand	1.70	1.69	2.28	2.72
.25–.1	Fine sand	6.79	3.13	9.09	5.04
.1–.05	Very fine sand	13.43	9.62	17.98	15.50
.05–.01	Silt	17.36	13.77	23.25	22.18
.01–.005	Fine silt	5.13	3.05	6.87	4.91
.005–.0001	Clay	29.88	30.46	40.01	49.07
		74.68	62.08	100.00	100.00
	Organic matter, water, loss	25.32	37.92		
		100.00	100.00		
	Loss by direct ignition	24.39	34.64		

It will be seen that there are 24.39 per cent and 34.64 per cent of loss on ignition, respectively, in the soil and subsoil. * * * This indicates a large amount of organic matter in this soil, and this accumulation of organic matter indicates a very limited supply of air. * * * The following table gives the mechanical analysis of a soil near Sumter, South Carolina, very similar to the above, but probably not so good for rice:

Mechanical analysis of rice land (South Carolina).

Diameter.	Conventional names.	0–12 inches.
mm.		
2–1	Fine gravel	0.15
1–.5	Coarse sand	1.39
.5–.25	Medium sand	7.65
.25–.1	Fine sand	10.16
.1–.05	Very fine sand	17.41
.05–.01	Silt	21.10
.01–.005	Fine silt	5.25
.005–.0001	Clay	22.88
		85.99
	Organic matter, water, loss	14.01
		100.00
	Loss by direct ignition	17.05

[There was here] an abundant and constant supply of moisture in the saturated subsoil.

Report of the statistician (*Division of Statistics, Report No. 103, n. ser., Apr., 1893, pp. 99–140*).—This includes the following articles: Condition of winter grain; farm animals; European crop report for March, 1893; and freight rates of transportation companies.

Insect Life (*Division of Entomology, Insect Life, vol. v, No. 4, Apr., 1893, pp. 213–288, plate 1, figs. 15*).—This number contains the following articles:

The Orange aleyrodes (*Aleyrodes citri*, n. sp.) (pp. 219–226).—An editorial article on this little Homopterous insect, which has for years been known to infest the orange groves of Florida, and has appeared in more northern greenhouses, and very recently in Louisiana. The species is described and illustrated with figures of its different stages, and an account is given of its habits, life-history, and remedies, together with brief mention of its natural enemies. The remedy consists in applying kerosene emulsion early in the spring, soon after the eggs have hatched, repeating it with the two following generations of the inseet.

The pear tree Psylla (pp. 226–230).—This article is also editorial and treats of the life-history, habits, and structure of *Psylla pyricola*, a distinctive species in the pear orchards of New York, the statements being founded mainly on the observations of M. V. Slingerland, published in Bulletin No. 44 of the New York Cornell Station (E. S. R., vol. IV., p. 472). The illustrations are from the same source. Kerosene emulsion is also found to be efficient against this insect.

The Langdon non-swarming device, Frank Benton (pp. 230–235).—An illustrated description of a new system of preventing bees from swarming. The advantages of the system are also given in detail. The writer expects that by constant use of the non-swarming attachment for beehives a strain of bees may in time be developed in which the swarming instinct will be wanting, a result long sought for.

Notes on Aphididæ, H. Osborn and F. A. Sirrine (pp. 235–237).—An article on the alternate food habits of several species of plant lice of the following genera: *Siphonophora, Rhopalosiphum, Hyalopterus, Monellia, Callipterus, Tetraneura, Colopha, and Pemphigus. Pemphigus attenuatus*, n. sp. is described.

Belvosia—a study, S. W. Williston (pp. 238–240).—A consideration of the validity of several species of the Tachinid genus *Belvosia*, illustrated with a plate of 9 figures.

Observations on the bollworm in Mississippi, S. B. Mullen (pp. 240–243).—A somewhat practical article on the bollworm of cotton, the habits and food plants of the larva and moth, the diseases of the insect, its natural enemies, hibernation, and treatment. The writer suggests the use of peas as an aid to corn for a trap crop for this insect. The peas should be planted with the cotton.

Notes on Entilia sinuata, Mrs. M. E. Rice (pp. 243–245).—Notes on this common Homopterous insect, its habits and its relations to ants.

The food plants of some Jamaican Coccidæ (II), *T. D. A. Cockerell* (pp. 245–247).—A list of Jamaican bark lice arranged according to their food plants.

Observations upon some Hymenopterous parasites of Coleoptera, F. H.

Chittenden (pp. 247–251).—Notes on the breeding habits and host relations of certain parasitic Hymenopterous insects that affect Coleoptera. Species of the following genera are considered: *Ephialtes, Bracon, Doryctes, Cœnophanes, Helcon, Cenocœlius, Meteorus, Euphorus, Homalotylus, Eupelmus, Catolaccus, Anoxus, and Cephalonomia.*

Report on the Australian insects sent by Albert Koebele to Ellwood Cooper and B. M. Lelong, D. W. Coquillett (pp. 251–254).—A report made to the entomologist of this Department upon certain beneficial insects which were sent from Australia during 1891–'92, and subsequently liberated in different places in California.

The genus Dendrotettix, C. V. Riley (pp. 254–256).—A consideration of a genus of tree-inhabiting locusts, for which the name *Dendrotettix*, nov. gen. is proposed. *D. longipennis*, n. sp. is described. *D. quercus*, Riley MS. is considered a variety of *longipennis*.

General notes (pp. 259–287).—Among the topics treated are the following: An enemy of the screwworm fly; the Archippus butterfly eaten by mice; notes on some insect pests of the Fiji Islands; entomology at the Iowa State University; parasites of animals transmissible to man; further illustrations of the rose slug; cockroach egg parasites; the Hymenoptera of Australia; the genus *Mirax;* an important paper on butterflies; cankerworms in California; tent caterpillars in Massachusetts; results of codling-moth legislation in Tasmania; a vine pest in Australia; the sugar-cane borer again; the mustard beetle in England; new species and genera of *Rhynchophora;* westward spread of the clover-leaf weevil; the larval habits of the acalyptrate *Muscidæ;* a blood-sucking Chironomid; the family *Apioceridæ;* the California remedy for the San Jose scale; introduction of the long scale into California; imported scales in California; the Membracidæ of North America; a new enemy of the tomato; an insect enemy of lace curtains; locusts in South Africa; North American species of Hippiscus; on harvest spiders; and the zebra caterpillar on the California coast.

The hawks and owls of the United States, A. K. FISHER (*Division of Ornithology and Mammalogy, Bul. No. 3, pp. 210, plates 26*).—An account of the geographical distribution, food habits, and life history of 73 species of hawks and owls, with descriptions and tabulated notes on examination of stomachs. The bulletin is illustrated with 26 colored plates. The following general statements regarding the results of the investigation on the food habits of these birds is taken from the letter of transmittal by Dr. C. H. Merriam:

> The statements herein contained respecting the food of the various hawks and owls are based on the critical examination, by scientific experts, of the actual contents of about 2,700 stomachs of these birds, and consequently may be fairly regarded as a truthful showing of the normal food of each species. The result proves that a class of birds commonly looked upon as enemies to the farmer, and indiscriminately destroyed whenever occasion offers, really ranks among his best friends, and, with few exceptions, should be preserved and encouraged to take up their abode in the neighborhood of his home. Only six of the seventy-three species

and subspecies of hawks and owls of the United States are injurious. Of these, three are so extremely rare they need hardly be considered, and another (the fishhawk) is only indirectly injurious, leaving but two (the sharp-shinned and Cooper hawks) that really need to be taken into account as enemies to agriculture. Omitting the six species that feed largely on poultry and game, 2,212 stomachs were examined, of which 56 per cent contained mice and other small mammals, 27 per cent insects, and only 3.5 per cent poultry or game birds. In view of these facts the folly of offering bounties for the destruction of hawks and owls, as has been done by several States, becomes apparent, and the importance of an accurate knowledge of the economic status of our common birds and mammals is overwhelmingly demonstrated.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Fat extraction, L. GEBEK (*Zeitschr. angew. Chem., 1893, pp. 253–255*).—Gypsum, animal charcoal, and Spanish earth (chalk) were used in the extraction tube to purify the ether extract. Although the first two gave a comparatively pure ether extract, they did not give concordant results, and in the case of charcoal a certain amount of the free fatty acids appeared to be retained along with the coloring matter and other impurities. These objections do not apply to Spanish earth properly prepared. Previous to use the fine ground earth is shaken up in water, enough sulphuric acid added to replace the carbonic acid, and the whole then brought to dryness and ignited. The material thus obtained is ground until all of it will pass through a 2 mm. sieve.

An ordinary extraction tube is used. The bottom of this is plugged with a wad of cotton, on which is placed a layer of Spanish earth 3 to 4 cm. deep. Then follows a mixture of the substance to be extracted, with an equal volume of the earth, and finally another plug of cotton. The extraction requires from four to five hours. Previous drying of the substances causes the results to be too low. Water free ether gives slightly lower and probably more correct results than that containing water.—W. H. B.

Recent researches on the microörganisms which fix nitrogen, BERTHELOT (*Compt. rend., 116 (1893), pp. 842–849*).—In recent investigations on the microörganisms which cause the fixation of nitrogen by humus soil, the author has endeavored to isolate definite species and to cultivate them in artificial media. He has given special attention to bacteria taken from the soil and from plants which contain no chlorophyll. The bacteria taken from the soil were studied in mixed cultures or as isolated species. The other microörganisms were bacteria found on the roots of legumes (lupines) and pure cultures of *Aspergillus niger*, *Alternaria tenus*, and a *Gymnoascus*. The cultures of bacteria taken from the soil were made in different nutritive media, all of which were rich in hydrocarbon, and contained an amount of nitrogen deemed sufficient to support the life of the microbes at the beginning, but so small that there could be considerable relative increase of nitrogen at the end. For this purpose different solutions were employed, including humic acid, kaolin, tartaric acid, sugar, Cohn's solution diluted, a similar

solution without free acid, etc. Sufficient water was added to give the mass a pasty consistence. The cultures were made in flasks varying in size from one half to 6 liters, and the nutritive solutions were carefully sterilized. The cultures were kept in glass culture ovens during several months at a temperature between 20° and 25° C. Stoppers of cotton or emery were used in the flasks.

In case the flasks used in such experiments are tightly closed their dimensions should be such that there would be a notable proportion of oxygen at the end of the experiment, but if the stopper of wadding is used, the gradual renewal of the interior air would secure this condition. The oxidation, however, should not be too active. If the bed of the culture is too small—that is, if the relation between the oxygen of the air and the living organic matter is too immediate and considerable—the microörganisms are destroyed, or, more strictly, cease to fix nitrogen.

The 6-liter flasks gave negative results, or in a few cases losses of nitrogen, while the flasks holding one half to 1 liter, which contained the same mixtures, placed in the same conditions, showed considerable fixation of nitrogen. This result tends to exclude in the case of the flasks not having the emery stoppers the hypothesis of a considerable absorption of nitrogenous compounds derived from the air. This hypothesis is also excluded by the testimony of the flasks having emery stoppers and by the check experiments made at the same time with sterilized mixtures containing no cultures, but submitted to exactly the same conditions.

The microbes isolated from the soil for use in these experiments are described as follows:

Bacillus A: Length 2.1μ, width 0.6μ. It did not liquefy gelatin, but developed on its surface round prominences, visible to the naked eye, with an oily appearance. In culture broth it produced after 12 hours a general agitation; at the surface a thick scum was formed which was precipitated to the bottom of the liquid. In its general aspect this microbe appeared to be identical with that which produced fixation of nitrogen with the aid of humic acid in preceding experiments by the author (*Compt. rend.*, 115 (1892), p. 569; E. S. R., vol. IV, p. 502).

Bacillus B: Length 2.1μ, width 0.6μ. In punctures on gelatin it rapidly formed a funnel and liquefied the gelatin.

Bacillus E: Length 3.1μ, width 0.9μ. It liquefied gelatin.

Bacillus F: Length 1.4μ, width 0.5μ. It did not liquefy gelatin, but produced colonies very flat, dry, and squamose.

The general data for the experiments are tabulated as follows:

Fixation of nitrogen by bacteria of the soil during three and one half months.

Kind of culture.	Nutritive solution.	Size of flask.	Kind of stopper.	Nitrogen.		
				Initial	Final.	Per cent gained.
		Liters.				
Mixed culture	Humic acid	1	Emery	7.7	12.2	57
Do	......do	6	Cotton	38.4	36.0	....
Do	Humic acid and kaolin	1	Emery	8.3	12 7	52
Do	......do	6	Cotton	41.3	41.1	....
Do	Kaolin	1	....	7.9	19.7	150
Do	......do	6	....	34.5	45.5	32
Bacillus A	Humic acid and kaolin	1	....	10.2	18.6	80
Do	Cohn's solution	0.6	Cotton	13.3	19.2	44
No culture	......do	0.6	....do	13.0	14.0	....
Bacillus B	......do	6	....	42.3	47.0	....
Do	......do	1	....	11.0	13 0	....
Do	Kaolin, sugar, and humic acid	0.6	Cotton	17.0	19.0	....
Bacillus E	Kaolin, humic acid, and Cohn's solution.	1	....	10.7	18.6	74
Do	Kaolin, sugar, and Cohn's solution.	0.6	....	13.8	18.9	37
Bacillus F	Humic acid, kaolin, and Cohn's solution.	6	....	42.9	44.0	....
Do	......do	1	....	11.0	13.0	....
Do	Kaolin, sugar, and Cohn's solution.	0.6	....	16.4	16.7	....

These experiments indicate that the soil contains forms of bacteria which cause the fixation of nitrogen in organic matters suitable for their nutrition. The cultures of isolated species indicate that some bacteria have this property and others do not.

Portions of roots of lupine containing tubercles were crushed in water, and cultures were made with a few drops of this liquid in a nutritive medium consisting of humic acid with Cohn's solution. The experiment lasted four months, and showed a gain of 50 per cent of nitrogen.

The data obtained in experiments with *Aspergillus niger* and *Alternaria tenuis* are given in the following tables:

Fixation of nitrogen by pure cultures of Aspergillus niger during one month.

Nutritive solution.		Nitrogen.		
		Initial.	Final.	Per cent gained.
Cohn's solution and 1 gram tartaric acid (without culture).	Flask (0.6 liter) with cotton stopper.	24.9	24.4	....
Cohn's solution and 1 gram tartaric acid (with culture).	......do	24.9	31.3	26
Do	Watch glass under bell-jar on moist plate.	27.1	32.9	22
Do	......do	27.1	37.1	37
Do	......do	27.1	32.1	18
Do	......do	27.1	36.6	35

Fixation of nitrogen by pure cultures of Alternaria tenuis during four months.

Nutritive solution.	Nitrogen.		
	Initial.	Final.	Per cent gained.
Kaolin, sugar and Cohn's solution (without culture)	11.3	13.0	....
Kaolin, sugar and Cohn's solution (with culture)	18.1	26.9	49
Do	18.1	27.1	50
Do	18.1	24.7	36
A different solution	11.3	22.4	98

These tests were in flasks holding 0.6 liter, with cotton stoppers.

Cultures of a *Gymnoascus* in clay sand showed fixation of nitrogen equivalent to 36, 75, and 143 per cent in three different trials.

These experiments show that there are quite diverse species of microörganisms without chlorophyll, which can fix nitrogen, especially certain bacteria of the soil.

It did not seem possible to sustain the nutrition of these organisms with the carbon and hydrogen resulting from the decomposition of carbonic acid and atmospheric moisture. Their nutrition is, however, correlated with the destruction of certain hydrocarbons, such as sugar and tartaric acid, which furnish nutriment for bacteria and other microörganisms. At the same time that these organisms fix nitrogen they must find, in the medium where they grow, proper materials for their nourishment. It also appears necessary that these materials should at the outset contain some nitrogenous substances to give these inferior organisms the minimum of vitality indispensable to the free absorption of free nitrogen, but if these substances are too abundant the bacteria will live preferably at their expense. The experiment shows that bacteria flourish better in media rich in combined nitrogen than in those which contain but little where they are obliged to put forth special efforts to fix free nitrogen. Without doubt a condition of this kind determined the limit of the absorption of nitrogen by certain soils in former observations by the author.* In all these cases the humus, or, more exactly, the hydrocarbons which it contains, will be exhausted more or less rapidly under these manifold influences if the necessary organic materials are not reproduced by the growth of the plants containing chlorophyll. The organisms fixing nitrogen and those fixing carbon play complementary rôles. Either they live independently of each other or they are associated in symbiosis. In any case the beginning of the fixation of nitrogen is not in the plants of higher order, but in certain lower microörganisms which live in the soil.—A. C. T.

The direct and indirect influence of light on plant respiration, W. Detmer (*Ber. deut. bot. Ges., 11, pp. 139–148*).—After stating some of the conflicting opinions regarding the direct influence of light and darkness on the respiration of plants, the author gives in detail the

* Ann. Chim. et Phys., 14, sér. 6, p. 487.

results of forty experiments to determine the influence of direct sunlight and diffused light, other conditions being equal. The parts of plants selected for the experiments were the corollas of *Crepis biennis*, the petals of a rose, the roots of sprouting plants of *Vicia faba*, and young sporocarps of *Agaricus campestris*. The specimens selected were free from chlorophyll, in order that that should not exert an influence. The plants used were placed in aspirators into which moist air was conducted, after its carbon dioxide had been removed. After passing over the plants it was led through a solution of baryta, and the amount of CO_2 ascertained by titration.

The author concludes from the results obtained that the amount of CO_2 produced by a plant is immediately proportional to the consumption of the reserve food material contained in the plant.

The amount of CO_2 produced gradually diminishes with the progress of the experiment.

In homologous parts of plants under similar conditions, the ratio of respiration either in light or darkness is the same.

The author found that the objects of his experiments respired with practically the same energy, and a change of illumination from sunlight to darkness had no direct influence on the plant's respiration.

In the indirect influence the author found an undoubted relation between active assimilation and the respiration of the plants. Whatever tended to increase one had a like influence on the other.

The author made numerous observations, two hours apart, of several plants to determine whether there was a periodicity of respiration. The results obtained, as expressed in tables, show no constant variation and the author doubts the existence of a daily period of respiration.—W. H. E.

The metabolic changes produced in sprouting potato tubers, W. DETMER (*Ber. deut. bot. Ges., 11, pp. 149-153*).—Experiments were conducted to observe the changes in potato tubers when grown under various conditions of light and moisture.

Four lots of tubers were experimented with. No. I was grown in a dark, dry pasteboard box; No. II in a pasteboard box covered with glass, but in a dry chamber; Nos. III and IV were in moist sand, the first in the dark, and the other covered by a glass bell jar. The tests were begun in January and continued for four months. The pieces of apparatus were placed in a north window of a room which was heated in winter.

In Nos. II and IV the developed sprouts became strong stems. Their color was natural and they were very pubescent and well provided with leaves. In Nos. I and III in the dark the sprouts attained about the same length, but were not so stout and of course of a pale color. In the moist sand numerous roots were developed, while in the dry chambers there were very few. At the expiration of four months the tubers and sprouts were tested for their total dry matter, diastase, sugar,

total nitrogen, albuminoid nitrogen, and respiration energy. At the beginning of the experiment all the tubers of the four lots were practically equal in dry material. At the end of four months the relative amounts of dry material were as follows: No. I, 40.53 per cent; No. II, 27.66 per cent; No. III, 23.20 per cent; No. IV, 23.26 per cent. The evaporation varied but little for the corresponding sets of experiments. They all grew practically an equal amount of sprouts, all of which transpired equally. The author confirmed his previous observations that diastase is not recognizable in unsprouted tubers, but may be found without great difficulty in the growing ones. The amount of ferments was about the same in the first three lots, while the last, the lot growing under glass in a moist atmosphere, contained much more ferment than the others.

The following table will show the ultimate changes wrought in each lot. They are to be considered as equal at the start. The number of tubers in each case is ten.

Respiration of sprouting potatoes in light and darkness.

	Dry atmosphere.		Moist atmosphere.	
	Dark.	Light.	Dark.	Light.
Weight of tubers..........grams..	404.00	550.00	645.00	685.00
Dry substance..........do....	163.70	152.10	149.60	159.30
Sugar..........do....	1.15	0.02	2.36	5.17
Total nitrogen..........do....	1.86	1.76	1.74	1.84
Albuminoid nitrogen..........do....	1.29	1.10	0.99	1.11
CO_2 per hour at 20° C..........mg....	7.18	13.15	9.10	16.61
CO_2 produced for 100 grams dry substance..........do....	4.39	8.63	6.08	10.42

The author concludes that light acts toward germinating potatoes as does heat. A high temperature is the best for growth, but a lower one for respiration. Accordingly, such a temperature as decreases the cell growth increases the carbonic-acid production. In a like manner the germinating potato tubers are influenced by a change in the light.—W. H. E.

The organic substances composing humus, BERTHELOT and ANDRÉ (*Compt. rend., 116 (1893), pp. 666–672*).—After a brief general discussion of the origin and formation of the humus of soils, the variation in humus content of soils is illustrated by ultimate organic analyses of four soils rich in humus and four poor in humus.

In the first series the total organic matter varied from 32.9 to 72.3 per cent, the organic carbon from 19.1 to 43.5 per cent, and the nitrogen from 1 to 1.7 per cent; in the second series (argillaceous sand) the total organic matter varied from 1.41 to 3.25 per cent, carbon from 0.82 to 1.91 per cent, and the nitrogen from 0.09 to 0.14 per cent. In the first case the nitrogen varied from 5 to 6 per cent of the total organic matter, in the second, 2 to 3 per cent. In the plants in general the nitrogen rarely runs as high as 3 to 4 per cent of the organic matter.

The cold-water extract of the organic matter of a sample of soil contained very small amounts of the organic principles. On treatment with cold, dilute solutions of alkalis, however, the amounts obtained were considerable. Sixty-seven and one-tenth per cent of the carbon originally present in the material was soluble in the alkali solution, and of this 27.1 per cent was precipitable by acid. Thirty-one and two-tenths per cent of the carbon was insoluble in the alkaline solution. The insoluble residue contained 4 per cent of nitrogen, the soluble extract precipitable by acids 5.6 per cent, and the soluble extract not precipitable by acids 9.7 per cent. Analysis of the material isolated from the matter precipitated from the alkaline solution by acid gave the following results: Carbon 55.2 per cent, hydrogen 6.8, nitrogen 3, oxygen 35, and ash 3.5.

One kilogram of each of two soils was also submitted to prolonged treatment with hydrochloric and hydrofluoric acid in the cold. In one case the insoluble matter obtained amounted to 25.6 grams, and in the other to 14 grams. The results of the analysis of this residue agree closely with those given above for matter soluble in alkali, except that hydrogen is about 1.5 per cent lower. When treated for three days with a 1 per cent solution of potash, 100 parts of these insoluble residues absorbed 44 and 42 parts of K_2O, respectively.

The insoluble salt obtained, washed until the wash water showed no alkalinity, had the following composition:

	Per cent.	
	I.	II.
Carbon	61.8	61.3
Hydrogen	5.7	6.1
Nitrogen	4.6	4.6
K_2O	6.2	3.7

These results are confirmatory of those obtained by the authors with artificial humic acid,* and serve to explain the absorbent power of soils for potash.—W. H. B.

The ammoniacal fermentation of the soil, A. MÜNTZ AND H. COUDON (*Ann. Agron., 19 (1893), No. 5, pp. 209–216*).—A variety of soils mixed with organic fertilizers placed either in sealed vessels with a limited supply of air, or in vessels plugged with cotton, which allowed of a gradual renewal of the air, were experimented on.

Comparative tests were made with unsterilized soils, with soils sterilized at 120° C., and with soils sterilized at 120° C. and subsequently inoculated with soil infusion.

The time of experiment varied in different cases from 42 to 105 days. In every test there was a notable amount of ammonia formed in the unsterilized or inoculated soils, the evolution being most active where

*Ann. Chim. et Phys., 24, sér. 6, p. 314; 25, sér. 6, p. 380.

the air was renewed, while in the sterilized soils the production of ammonia was absolutely arrested.

It was found that a temperature of fully 120° C. was required to bring about complete sterilization, thus showing the remarkable resistant power of the organisms to heat.

With the assistance of M. Kayser, two distinct species of *Bacterium*, one of *Bacillus*, and two of *Micrococcus*, were isolated in a pure state from one of the soils experimented upon. The microscopic characters of these species are given. Besides these, there were isolated from the same soil two species of molds, the common *Mucor racemosus* and a new species of *Fusarium*, to which the specific name *müntzii* is given. All of these organisms produced a notable evolution of ammonia in veal bouillon within ten days, and with all except one (a micrococcus) the same result was obtained in soils. The evolution was especially active in the soils inoculated with the two molds.

The results seem to warrant the conclusion that the formation of ammonia in the soil is the result exclusively of the conjoint activity of numerous lower organisms of very widely different characters.—W. H. B.

The manuring of summer crops with commercial fertilizers, F. Rovara (*Wiener landw. Ztg., 1893, pp. 234, 235*).—Numerous experiments by the author in Hungary led to the conclusion that in almost all cases superphosphate and nitrate of soda were profitable on root crops, whether sugar beets or other roots grown for feeding purposes. Manuring with 348 kg. of superphosphate and 87 kg. of nitrate of soda per hectare reduced the purity coefficient from 83.5 per cent on the unfertilized plats to 80.5 per cent on the fertilized plats, but the sugar content remained practically unchanged, being 12.78 and 12.80 per cent, respectively. The author's practice is to apply the superphosphate and to mix it with the soil before the seed is sown. He found that nitrate of soda should be applied as a top dressing after the plants have come up so as to avoid the formation of a crust over the seed bed.

Numerous experiments on oats and barley indicated that these crops did not pay for manuring as well as winter grain.—J. F. DUGGAR.

Experiments on the effect of various phosphatic manures on upland soil, O. Kellner, Y. Kozai, Y. Mori, and M. Nagaoka (*College of Agr., Tokio, Japan, Bul. No. 12, Mar., 1893, pp. 1–22*).—The soil experimented on was a "light, ferruginous kind of loam, rich in humus." It was placed in zinc cylinders open at both ends, 60 centimeters (23.6 inches) wide and 1 meter (39.37 inches) long, which were sunk nearly to their top in a level field.

The phosphates used were (1) double superphosphates containing 47.8 per cent of total phosphoric acid, 43.7 per cent of soluble phosphoric acid, and 3.1 per cent of reverted phosphoric acid; (2) precipitated cal-

cium phosphate containing 29.4 per cent of total phosphoric acid and 24.8 per cent of reverted phosphoric acid; (3) Thomas phosphate (75 per cent passed 0.25 mm. sieve) containing 21.8 per cent of total phosphoric acid; (4) steamed bone dust (85 per cent fine) containing 21.8 per cent of total phosphoric acid, 3.9 per cent of nitrogen, and 1.3 per cent of fat; (5) crude bone dust (37 per cent fine) containing 19.7 per cent of phosphoric acid, 4.7 per cent of nitrogen, and 1.9 per cent of fat; (6) raw crushed bones (16.6 per cent fine) containing 21.6 per cent of phosphoric acid, 4.6 per cent of nitrogen, and 14.1 per cent of fat; and (7) bone ash (93 per cent fine) containing 30.5 per cent of total phosphoric acid, and 4.9 per cent of reverted phosphoric acid.

Each cylinder received a certain amount of precipitated calcium carbonate, potassium sulphate, and ammonium sulphate before the addition of the phosphates. Each phosphate was applied in two quantities, a single and a double ration, and each quantity was applied to three cylinders. The rates of application were as follows: Double superphosphate 44.5 and 89 pounds per acre; precipitated calcium phosphate and Thomas phosphate 66.8 and 133.6; steamed bone dust, crude bone dust, and raw crushed bones 53.4 and 106.8; and bone ash 89.1 and 178.2 pounds per acre.

Four crops were grown in succession—barley, millet, wheat, and buckwheat. An additional quantity of nitrogen was applied before each successive crop, but no phosphate was added after the first application. The amounts of phosphoric acid assimilated by the different crops, as well as the increased yield of dry matter due to the different phosphates, are tabulated in full. The following table, calculated from these data, shows the relative manurial value of the phosphates on the successive crops.

Relative manurial value of different phosphates.

	First crop.	Average of first and second crops.	Average of first, second, and third crops.	Average of first, second, third, and fourth crops.
Double superphosphate	100	100	100	100
Steamed bone dust	79	77.5	82	81
Precipitated calcium phosphate	62	67.5	75	75
Crude bone dust	56	69	108	113
Crushed raw bones	56	64	113	122
Thomas phosphate	55	46	48	48
Bone ash	21	24	38	39

From these results the following conclusions are deduced:

(1) Of all phosphates applied, the double superphosphate was the most effective in the beginning, its rate of consumption by the first two crops cultivated in the first ten months not being surpassed by any of the other fertilizers. After that time, however, its solubility diminished, probably because the dibasic compounds formed after its application are gradually converted into tribasic and polybasic ones, from which the phosphoric acid can not be readily dissolved by the roots. It is, therefore, the best suited to crops of rapid development and to soils of medium ab-

sorptive power for phosphoric acid, and should be chiefly applied to crops cultivated in the spring or summer, a few days before sowing or transplanting.

(2) The precipitated calcium phosphate, which in our case consisted chiefly of dicalcium phosphate mixed with some tricalcium phosphate, was less active than the superphosphate, because its distribution in the upland soil can not be accomplished to that extent which is easily attained with the superphosphate. The monocalcium phosphate, the principal ingredient of the latter, dissolves in the fluids of the soil, and is then precipitated, thus assuming a state of extremely fine division, while the distribution of the precipitated calcium phosphate depends merely on the mechanical process of mixing. Though less rapid in the beginning, the action of the latter phosphate will usually continue longer than that of superphosphate.

(3) The three kinds of bone manure—steamed bone dust, crude bone dust, and raw crushed bones—gave very remarkable results. The first crop consumed from the steamed bone dust considerably more than from the two raw fertilizers, but the after effect of the unrecovered phosphoric acid of the former was much inferior to that of the two latter manures. It must, however, be kept in mind that our specimen of steamed bone dust had been deprived of a part of its gelatinoid substance, which, during its decay in the soil, assists in the dissolution of the phosphatic ingredients of bones, and accelerates the action on crops. Had our steamed bone dust been in a normal condition, its effect would have been certainly not much inferior to that of the superphosphate on the first crops. On the other hand, there is no great difference in the assimilability of the phosphoric acid of the crude bone dust and the raw crushed bones. These two manures had a good effect on the first two crops, but after having undergone decomposition in the soil for one year, their solubility increased so enormously that the third crop consumed from them more than even the superphosphate yielded to the first crop. This observation is of great practical importance. It goes to show that in countries with a warm climate and with copious rain, as in Japan, bone manures are most valuable even in quite a raw state, and that by early application or by a preparatory fermentation in the compost bed their manurial value may be easily and cheaply raised to that of the superphosphate. During our experiments on the college farm we have had frequent opportunity of proving that bone dust has a specially good effect on cereals sown in autumn, not only in reference to its phosphatic ingredients, but also to its content of nitrogen. The presence of fat does not deteriorate its value, but seems rather to secure a better after effect, as in our experiments the raw crushed bones with 14.07 per cent fat yielded more phosphoric acid to the third and fourth crops than the crude bone dust with only 1.33 per cent fat.

(4) The Thomas phosphate displayed with regard to the first crop, as well as to the three subsequent ones, approximately half the effect of the superphosphate. The excellent after effect attributed to this fertilizer by P. Wagner has not been up to the present perceptible in our experiments, in spite of the richness of our soil in humus and the copious rainfall.

(5) Bone ash was, as we had anticipated, a very insoluble manure, acting but slowly on the first two crops, but of increased efficacy in course of time. It should always be converted into superphosphate before its application.

W. H. B.

The results of experiments with oats in the years 1889–'92, G. LIEBSCHER (*Landbote, 1893, pp. 271–272*).—The results of experiments with 20 varieties of oats are summarized. The experiments were made by farmers in different localities. The author concludes that the difference in the productiveness of the best varieties of oats is not so considerable as is generally believed, but that this dif-

ference is sufficient to engage the farmer's attention. His results indicate that the adaptability of different varieties for certain conditions of soil and climate is generally overestimated. He considers any such adaptability which may exist due largely to the different quantities of water needed by different varieties.

Experiments in mixing varieties indicated that for rye and wheat it is advisable, where the wintering of the new and productive varieties is not safe, to mix these with the hardy native sorts. For oats the mixing of varieties was not advantageous.

The author concludes that the percentage of nitrogen and phosphoric acid is not influenced by the variety of oats, but that varying seasons exercise an influence in this matter. Oats are richer in protein and phosphoric acid in a warm, dry year than in a cold, wet year.

The author suggests that since the richness of the soil in phosphoric acid exerts an influence on the composition of the grain, the analysis of the grain may be taken as an indication of the richness of the soil.—J. F. DUGGAR.

The repression of potato rot by treatment with copper preparations, G. LIEBSCHER (*Deut. landw. Presse, 1893, No. 36, pp. 385, 386*).—The author conducted experiments through three seasons to test the value of copper preparations for the preventive treatment of potato rot.

On June 28, 1890, he sprayed a part of the crop with a 1½ per cent solution of Bordeaux mixture, at the rate of 30 gallons per acre. Four weeks later he again sprayed the plats, using a 2 per cent solution, at the rate of 50 gallons per acre. Notwithstanding this treatment, there was some disease on all the early sorts, while upon the late ones the disease did not appear, even when not sprayed. He considered the first spraying was made too late, and consequently the second was useless.

In 1891 three plats of about one third acre each were planted with a variety supposed to be very susceptible to rot. The first plat was untreated, the second received a dusting with copper steatite, and the third was sprayed three times with a 1½ per cent solution of Bordeaux mixture, at the rate of about 30 gallons per acre. Late in the season all three plats were attacked, and at the beginning of August all the potato vines were wilted. The treated vines remained green longer than the untreated ones, those receiving the copper steatite for about a day; those sprayed with Bordeaux mixture, from three to fourteen days. The crop from all three plats was as follows: Untreated, 32 bushels per acre; copper steatite, 42.7 bushels; and Bordeaux mixture, 48.1 bushels. In some instances the disease was so bad that a yield scarcely greater than the amount of the seed was obtained. The author thinks the cost of the treatment was justified by the increased yield.

In 1892 the experiment of the previous years was repeated on a plat of about 1¼ acres, divided into three parts. One was untreated, another was dusted three times with copper steatite, and the last sprayed three times with Bordeaux mixture, at about the same rate per acre as in the previous years. Fourteen varieties of potatoes were planted, and

the season being a very dry one the disease was at no time severe. About the end of August the effect of the copper upon each of the 14 varieties was plainly seen. The injurious effect on the plants, the author claims, could be readily seen, and the yield was correspondingly reduced. The season was a favorable one and the harvest large. Taking the yield from the untreated plats as 100, the total crop from the plats treated with Bordeaux mixture and copper steatite was 80 and 69, respectively; or the loss caused by the use of Bordeaux mixture was 20 per cent, and by the copper steatite 31 per cent. Instead of the usual gain attributed to the use of copper compounds there was here a very serious loss.

The author thinks the use of copper compounds may be of value in a wet season when the potato-rot fungus is developing and spreading rapidly, but in a dry season their repeated application will positively injure the crop more than the fungus; in other words, he considers the use of the compounds during a dry season as injurious to the potato plant.—W. H. E.

The destruction of caterpillars on cabbages, J. DUFOUR (*Chron. Agr. Cant. Vaud, 1893, No. 5, pp. 196, 197*).—Among numerous insecticides tried, the best for destroying caterpillars on the cabbage were soft soap and pyrethrum and liver of sulphur and soft soap. The last is made by dissolving 300 grams of soap and 50 grams of liver of sulphur in 10 liters of water. The cabbage must be repeatedly sprayed, as new caterpillars are hatched each day. On account of its corrosive action it is not possible to employ this insecticide on tender plants or on the grape in bloom, but on the cabbage its effect is entirely satisfactory.—J. F. DUGGAR.

The nun (*Liparis monaclia*), H. BADOUX (*Chron. Agr. Cant. Vaud, 1893, No. 4, pp. 143–153*).—An account of the ravages of this insect on the spruce and pine forests of Europe, with the methods of combating the pest.—J. F. DUGGAR.

The digestibility of twigs and brushwood, A. GÜNTHER, A. HEINEMANN, J. B. LINDSAY, and F. LEHMANN (*Journ. Landw., 41 (1893), pp. 65–83*).—Beech twigs, poplar twigs, and acacia twigs were fed to sheep in order to determine the digestibility of these materials. The beech twigs consisted partly of old material, while the acacia twigs were young. The young poplar twigs covered with leaves were cut in July, and had a maximum diameter of 1 cm. at the larger end. The dry substance of the three feeding stuffs had the following composition:

Analyses of the dry matter of twigs.

	Crude protein.	Crude fat.	Crude cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Beech twigs	4.66	1.85	45.55	44.85
Poplar twigs	7.81	3.36	39.80	45.25
Acacia twigs	11.25	1.90	36.00	46.71

In each case the digestibility of hay was first determined, then the digestibility of a mixture of hay and bean meal, and finally the twigs were added to this mixture. The digestion period consisted of seven days and was preceded by a preliminary period of the same length. The following digestion coefficients were obtained for the three substances under trial:

Digestion coefficients for twigs.

	Crude protein.	Crude fat.	Crude cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Beech twigs	16.2	9.0	7.0	16.4
Poplar twigs	38 8	39.0	27.5	51.3
Acacia twigs	55.8	22.7	21.4	47.4

One hundred pounds of the water-free substance contained the following amounts of digestible matter:

Digestible material in the dry matter of twigs.

	Crude protein.	Fat.	Crude cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Beech twigs	0.76	0.17	3.13	7.36
Poplar twigs	3.03	1.31	10.93	23.21
Acacia twigs	6.28	0.43	7.70	22.14

The authors conclude that the difference in the digestibility of these three substances is due rather to the age at which the material was harvested than to the plant itself. The younger the twigs the higher their digestibility, and they attain their maximum digestibility when covered with leaves, since the leaves are more easily digested than the stems.—J. F. DUGGAR.

Craonnais swine, J. BIZE (*Chron. Agr. Cant. Vaud, 1893, No. 5, pp. 175–184*).—The author found in breeding together brother and sister of the Yorkshire breed and comparing the weight of the progeny with that of the offspring of parents not related, that in two years the inbreeding resulted in a loss of 61.6 pounds of live weight per head by the time the pigs had attained the age of 12 months.

In his endeavors to improve the hogs of the Canton of Vaud the author secured the French breed Craonnais and compared it with the pure Yorkshire and with the Craonnais-Yorkshire cross. He found the Craonnais larger than the Yorkshire and the cross, and requiring eighteen or twenty months for maturity. The cross was completely developed at fourteen or fifteen months, afforded a finer and more compact flesh than the Craonnais and a smaller proportion of waste in slaughtering. The cross was quiet in disposition and better suited to confinement.

The following figures give the weights of three pigs of the same age fed together:

Age.	Craonnais.	Yorkshire.	Cross.
Months.	*Pounds.*	*Pounds.*	*Pounds.*
6	116.6	94.6	103.4
9	226.6	151.8	182.6
12	316.8	246.4	277.2
15	435.6	343.2	376.2

The pure Craonnais was fed until 22 months old, when he weighed 685 pounds gross, and netted 592 pounds.—J. F. DUGGAR.

The effect on the progeny of adding neutral calcium phosphate to the normal ration of the pregnant mother, L. GAFFENBERGER (*Journ. Landw., 41 (1893), pp. 57–64*).—The young rabbits of two litters from the same parents were analyzed. During one period of pregnancy the mother had received in addition to the ration of oats, green stuff, and hay, a quantity of phosphate of lime mixed with the food. During another period of pregnancy this mineral food was omitted. The average weight of the young rabbits and the percentage of ash, lime, and phosphoric acid were less when the phosphate of lime was fed.—J. F. DUGGAR.

Contribution to the study of tetanus, E. ROUX and L. VAILLARD (*Ann. Inst. Pasteur, 7 (1893), pp. 65–140*).—A review of the work previously published on this subject precedes an account of the researches of the writers.

The authors' method of rendering an animal immune against tetanus is as follows: The tetanic cultures are made on peptonized bouillon, aged four to five weeks. These cultures, after filtration, furnish a clear liquid, which is a tetanic poison of great strength, since $\frac{1}{4000}$ of a cubic centimeter kills a mouse. This, mixed with a solution of iodine, loses in large part its objectionable qualities, and constitutes the vaccine liquid which is not caustic. The animal is inoculated with increasing doses at intervals of several days. This method of procedure is rapid and convenient, and succeeds equally well with the Guinea pig, the horse, the sheep, and the cow. The more subject the animal may be to tetanus, the longer the period during which the vaccination is continued.

The serum from animals so treated possesses an antitoxic property. For measuring this antitoxic activity of the serum, the authors follow the method proposed by Behring. Its activity is represented by the weight of mice which one cubic centimeter of serum will render immune against an inoculation with the same amount of tetanic poison. When the serum is dried it may be kept indefinitely without losing its efficacy.

The immunity of animals inoculated with the vaccine liquid above mentioned, and afterwards with the pure poison, exists for a long time. For example, at the end of two years rabbits were still proof against

inoculations of poison which proved fatal to rabbits which had not been treated.

On the other hand, the authors found, contrary to the experience of Behring and Kitasato, that the immunity conveyed by the serum is not durable, but diminishes rapidly, and is lost in about fifty days.

The milk of vaccinated animals was found to be strongly antitoxic and conducted itself like the serum.

When the poison and the antitoxine were injected almost simultaneously into the same kind of tissue, but in different parts of the body, the poison diffused more rapidly and induced tetanus limited to the region where it was introduced. When the serum is injected before the poison, it prevents tetanus. Poison injected into the paw of a small animal was not so quickly fatal as when the same dose was introduced under the skin. The longer the time which elapses between the injection for the purpose of inducing tetanus and the remedial inoculation, the larger must be the doses of serum employed. After a certain time, varying with the animal, prevention is impossible. It is necessary to repeat the therapeutic injection from time to time until the contraction disappears.

The authors' experiments in the treatment of pronounced tetanus embraced 49 mice, 62 Guinea pigs, 11 rabbits, and 4 sheep. Of these, 43 animals were used as tests, and after infection were not treated; 39 died and 4 recovered. Of the 83 infected animals treated, 73 died and 10 recovered.

A review of the recorded cases of the treatment of tetanus in man by means of inoculation shows that results have not been favorable. Since large doses of serum will not cure tetanus and since small doses will prevent it, the authors suggest that the physician might use preventive treatment when called to attend an injury which might be expected to run into tetanus.—J. F. DUGGAR.

Bacteriological researches concerning suppuration, A. LUCET (*Ann. Inst. Pasteur, 7 (1893), pp. 324–330*).—This is a preliminary notice in which the author describes the organisms found in pus. All of these observations were made on milch cows. After separating the organisms which he considers accidental, the author enumerates five organisms which he considers as the true pyogenic microbes. He proposes for these the following names: *Streptococcus pyogenes bovis*, *Staphylococcus pyogenes bovis*, *Bacillus pyogenes bovis*, *Bacillus liquefaciens pyogenes bovis*, and *Bacillus crassus pyogenes bovis*.

Of these the most common is *Streptococcus pyogenes bovis*, next *Bacillus pyogenes bovis* and *Bacillus liquefaciens pyogenes*.

Streptococcus pyogenes bovis is not harmful when injected into Guinea pigs and rabbits subcutaneously, or as intra-peritoneal injections. Intra-veinous injections proved harmless for the rabbit.

Staphylococcus pyogenes bovis was equally harmless with rabbits and Guinea pigs, whatever the mode of inoculation.

Bacillus pyogenes bovis showed a variable virulence; in one case it quickly produced death when injected subcutaneously into a Guinea pig, while in other cases it was without effect.

Bacillus liquefaciens pyogenes bovis when intra-veinously injected into the rabbit caused large abscesses, which, however, did not open spontaneously.

Bacillus crassus pyogenes bovis was not harmful for rabbits, but caused the death of Guinea pigs in 36 or 48 hours after intra-peritoneal injection.—J. F. DUGGAR.

Comparison between the specific gravity test of must and analysis of wine, G. REY (*Chron. Agr. Cant. Vaud, 1893, No. 5, pp. 203, 204*).—The Oechsle specific gravity test for must was compared with analyses of wine to determine the accuracy of the first method in measuring the alcohol of wine. In two series of experiments, extending through eight years, the difference between the theoretical amount of alcohol and the amount found by analysis was extremely small. The average figures showed, in the first experiment, by the gravity test 9.6 per cent, by analysis 9.8 per cent; in the second experiment, by the gravity test 10.4 per cent, by analysis 10.2 per cent.—J. F. DUGGAR.

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The exchanges of carbonic acid and oxygen between plants and the atmosphere (*Sur les échanges d'acide carbonique et d'oxygène entre plantes et l'atmosphére*), TH. SCHLÖSING, JR.—*Ann. Inst. Pasteur, 7 (1893), No. 1, pp. 28-40; also, Compt. rend., 115 (1892), No. 16, pp. 881 and 1017.*

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Experimental researches on the pathogenic property of ensiled beet diffusion residue, and means of lessening the same (*Recherches expérimentales sur le pouvoir pathogène des pulpes de betteraves ensilées et les moyens de l'amoindrir*), S. ARLOING.—*Ann. Agron., 19 (1893), No. 3, pp. 113–149, figs. 4.*

Bacteriological researches on suppuration of cattle (*Recherches bactériologiques sur la suppuration chez les animaux de l'espèce bovine*), A. LUCET.—*Ann. Inst. Pasteur, 7 (1893), No. 4, pp. 325–330.*

Charbon bacteria in the mud from the bottom of a well (*Bactéries charbonneuses dans la vase du fond d'un puits*), DIATROPTOFF.—*Ann. Inst. Pasteur 7 (1893), No. 3, pp. 286, 287.*

The phosphates of milk (*Sur les phosphates du lait*), M. DUCLAUX.—*Ann. Inst. Pasteur 7 (1893), No. 1, pp. 2–17.*

The microbes and the fatty matters in cream and cheese (*Les microbes et la matière grasse*), E. DUCLAUX.—*Ann. Inst. Pasteur 7 (1893), No. 4, pp. 305–324.*

Experiments with cultivated yeasts in wine-making (*Essais avec les levures cultivées en 1892*), E. CHUARD.—*Chron. Agr. Cant. Vaud, 1893, No. 5, pp. 193–203.*

EXPERIMENT STATION NOTES.

GEORGIA STATION.—Mr. Gustave Speth, horticulturist of the station, died April 2, 1893, aged 54 years. The deceased was a native of Würtemberg, Germany. Hugh N. Starnes has been appointed to fill the vacancy. During two weeks in March the station dairymen assisted in conducting a dairy school at the University of Georgia, at Athens. The apparatus of the station was used for this purpose.

IDAHO STATION.—Three substations have been organized, as follows: No. 1, Grangeville, Idaho County, John Norwood, experimentalist, and W. E. Russel, farmer; No. 2, Idaho Falls, Bingham County, W. F. Cash, experimentalist, George Armstrong, farmer; No. 3, Nampa, Canyon County, T. T. Rutledge, experimentalist, O. F. Persons, farmer. Field work with grain, grasses, potatoes, and other vegetables has been begun at these substations. At Nampa an orchard is being planted and experiments with sugar beets will be conducted. The station at Idaho Falls is in the arid region, where irrigation is necessary to the growth of crops. Experiments with reference to the practicability of carrying on dairying in this region will be made at this substation. R. Milliken has resigned the directorship of the station.

UNIVERSITY OF MINNESOTA.—The biennial report of the board of regents for the years 1891 and 1892 contains the following description of the dairy building recently erected and equipped at a cost of $17,600:

"The dairy building is of a commodious size, built of brick in a thoroughly substantial manner after the most modern plans, with a complete equipment, including apparatus for experiments, handling of milk, and butter and cheese-making, as well as machinery and outfit necessary for giving thorough and complete instruction to students in the agricultural department in the latest and best methods of dairy work.

"The building is two stories high, thoroughly plumbed, and provided with cold-storage rooms. There are four office rooms above and one large room for general purposes. It is heated with steam throughout, supplied from a 40-horse-power boiler. The steam separator is driven by a small engine; on the main floor are two rooms each 42 by 30 feet, both well lighted and ventilated and fully equipped for butter and cheese-making. There is an abundant supply of hot and cold water. The lecture room is large and arranged so that animals may be taken before students ot the agricultural school for illustration in stock-raising."

The number of students in the school of agriculture has increased from 38 in 1888 to 135 in 1892. The total number of students in the university is now about 1,500.

NEBRASKA STATION.—Work on chinch-bug diseases has been undertaken by L. Bruner, entomologist of the station. F. S. Billings, investigator of animal diseases, and F. W. Taylor, horticulturist, have resigned.

NEW JERSEY STATIONS.—At a meeting of the governing board of the State station, held April 20, 1893, the following officers were elected: President, A. W. Duryee; secretary, W. R. Ward; treasurer, I. S. Upson; and director of the station, E. B. Voorhees.

NEW YORK STATE STATION.—C. E. Hunn, assistant horticulturist, is no longer a member of the station staff.

OHIO STATION.—The State legislature has appropriated $9,500 to this station for 1893, to be expended for the following purposes: Live stock, including the foundation of a few herds of pure-bred cattle and sheep, $4,350; implements, farming

machinery, and farm supplies, $2,250; special work in entomology, $400; substation for field experiments with fertilizers, $1,000; preparation for main building, $1,000; and expenses of board of control, $500. A large orchard is being planted. Ten miles of tile drain have been put in, and as much more will be laid during the coming season. The erection of the main building will not be undertaken until next year.

PENNSYLVANIA COLLEGE.—The State legislature, with only two dissenting votes, has passed an act appropriating $90,720 for the benefit of the college during the next two years, including $30,000 for a new building for the departments of engineering, and $32,000 for the maintenance of the departments of mining, electrical and civil engineering, chemistry, and agriculture.

UTAH COLLEGE.—F. B. Linfield, formerly foreman of the farm of the Ontario Agricultural College, and afterwards connected with the traveling dairy of Ontario, has been appointed to the chair of animal husbandry at the Utah College. He will have most of his time to devote to investigations in dairying.

VERMONT COLLEGE AND STATION.—W. W. Cooke has resigned the position of director of the station and professor of agriculture in the college, to take effect October 1. He has been director of the station since its organization in 1886.

WASHINGTON COLLEGE.—The board of regents recently appointed is constituted as follows: Charles R. Conner, president, Spokane; T. R. Tannatt, vice-president, Farmington; J. W. Stearns, treasurer, Tekoa; H. T. Blandford, Wallawalla; E. S. Ingraham, Seattle.

SPAIN.—Bulletin No. 2 of the Agronomic Station connected with the Agricultural High School at Madrid, Spain, contains a report on the work of the year 1892, by the director, José Hurtado de Mendoza, including analyses of soils, fertilizers, etc.; field experiments with wheat, barley, chick-pea (*Cicer arietinum*), and *Vicia faba;* and pot and box experiments with different crops.

BOTANICAL LABORATORY, HAMBURG.—A pamphlet has been recently issued containing the following papers by Dr. O. Burchard, originally published in English journals: Characteristics of the American red clover in the field; Red clovers from various States of North America; Germination of grass seeds without integuments; and Temperature in germinating experiments.

ON THE LIBERATION OF NITROGEN DURING PUTREFACTION, H. B. GIBSON (*Amer. Chem. Journ., 15 (1893), No. 1, pp. 12–18*).—Lean beef and blood serum were allowed to putrify in glass bell-jars varying in size from 1 to 2 liters. The several portions, not exceeding 1 gram in weight, were placed in small watch glasses arranged on metal stands. They were each moistened with distilled water at the rate of from 2 to 6 c. c. of water per gram of substance. Putrefaction was induced in one set by adding a drop of very dilute emulsion of putrid meat, and in another by the addition of a couple of drops of dilute soil infusion. The temperature varied from 6° or 8° to 25° C., and often changes of 12° to 15° occurred within twenty-four hours. Air washed by dilute aqueous solutions of caustic soda and sulphuric acid was passed through the jars, as a rule every day, at the rate of about 4 bubbles per second, the average daily quantity thus admitted to each jar being approximately equal to twice its capacity. In one series the ammonia evolved in the jars was absorbed in dilute sulphuric acid. In a second series the air was drawn through concentrated sulphuric acid to absorb indol, skatol, etc., as well as ammonia. The experiments lasted from eighty-two to one hundred and twenty-two days, and the loss of nitrogen was determined by the "difference" method. Tests were made for nitrates with negative results. The results are thus summarized by the author:

"(1) Liberation of nitrogen may take place during the process of putrefaction.

"(2) In the experiments reported the liberation of nitrogen has been dependent on the inoculation, and certain microörganisms (found in the putrid flesh) seem incapable of carrying on this process in any marked degree, while others (found in the soil infusion) have caused a marked loss of nitrogen.

"(3) The microörganisms have produced liberation of nitrogen independent of the process of nitrification."

THE INFLUENCE OF THE MOON ON RAINFALL (*Science, Vol. XX, No. 513, p. 310.*)—From recent contributions to this subject by Mansfield Merriman, Ph. D. of Lehigh University, Pennsylvania, and Prof. H. A. Hazen, of Washington, D. C., it appears that the widespread belief in the influence of the moon on the weather probably has some foundation in fact, particularly as regards the effect on the occurrence of thunderstorms and the dispersion of clouds under the influence of the full moon. Prof. Merriman has tabulated the rainfall at Bethlehem, Pennsylvania during 1881-'90. "The amount of rainfall in each year was obtained for the new moon and for each of the three days preceding and following, and also for the other quarters." He arrives at the conclusions that the rainfall is liable to increase after the new moon; that the full moon is generally followed by a decrease in rainfall; that the wettest period in the lunar month is near and before the new moon, and that the dryest period is near and before the first quarter.

Prof. Hazen briefly reviews the foreign work on this subject, stating that the results have been largely of a negative character, except that there seems to be a slight influence of the moon, or perhaps the tide, on thunderstorms, and that the full moon appears to have the power to disperse clouds. He also refers to researches at New Haven, Connecticut, from 1873-'80, which show that there was "nearly a half more rain just before and after new moon than full moon." He computes the data for rainfall at Philadelphia, Pennsylvania, for the fifteen years, 1871-'85, and for the ten years, 1882-'91. "In the first period of fifteen years there is a preponderance of rain at the time of the new moon. In the second period for the three days about each phase the result is similar to that of Prof. Merriman, though the difference of 2 inches between new and full moon is very slight. When we take the five days about each phase, however, we see that the new moon has 13.5 inches more rain than the full." The observation of Prof. Hazen confirms the general belief that the full moon has the power of driving away clouds.

BURNT EARTH IN SEED GERMINATION.—A writer in *Garden and Forest*, vol. VI, p. 115, recommends the use of burnt earth for slow-germinating seeds. Clayey soil is burned in a stove or furnace to a red heat, thus ridding it of the causes of fermentation and sourness. Seed pans filled with such soil may be kept moist indefinitely without fear of injury.

DELPHINIUM AS AN INSECTICIDE.—In *Revue Horticole*, 65 (1893), No. 7, p. 146, reference is made to experiments by Laboulbène which indicate that a decoction of *Delphinium* plants may be used as an insecticide for the beet noctuid.

ARBOR DAY FOR FRANCE.—In an extract from a memoir by J. Jeannel on Deforestation and public hygiene (*Le déboisement et l'hygiène publique*) published in *Comptes rendus*, 116 (1893), p. 659, the desirability of organizing a movement to establish an institution analogous to the American Arbor Day is strongly urged, on the ground that this is necessary in order to put an end to deforestation and to hasten the reforestation of the mountain regions of France.

RECENT ARTICLES BY STATION WORKERS.—The following list of titles of articles by station and Department workers is taken from the current volume (VI) of *Garden and Forest*: Impotency of grape pollen, S. A. Beach, p. 199; Climatic influence of forests, B. E. Fernow, p. 147; A serious filbert disease, B. D. Halsted, p. 134; Fertilizing orchards, I. P. Roberts, p. 71; Bird notes for horticulturists, W. B. Barrows, p. 58; Hygienic significance of forest air and forest soil, B. E. Fernow, p. 34; Why do some promising varieties fail? L. H. Bailey, p. 2; Diseases of Gloxinias, E. G. Lodeman, p. 9; Phosphate for fruit, G. C. Caldwell, p. 121; Relation of yield of potatoes to weight of tubers planted, C. S. Plumb, p. 127; Are varieties of orchard fruits running out? L. H. Bailey, p. 87; Club roots of turnips, B. D. Halsted, p. 78; Prevention of apple scab, S. A. Beach, p. 58.

An article by G. F. Atkinson on the biology of the organism causing tubercles on roots of the Leguminosæ is begun in *Bot. Gazette*, vol. XVIII, p. 157.

Free nitrogen assimilation is the subject of an article in *Torrey Bulletin*, vol. XX, p. 148, by H. W. Conn.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

APRIL, 1893.

DIVISION OF CHEMISTRY:

Bulletin No. 37, December, 1892.—Record of Experiments with Sorghum in 1892.

DIVISION OF ENTOMOLOGY:

Bulletin No. 28, October, 1892.—The More Destructive Locusts of America North of Mexico.

DIVISION OF FORESTRY:

Circular No. 10.—Suggestions to the Lumbermen of the United States in Behalf of More Rational Forest Management.

DIVISION OF STATISTICS:

Report No. 103 (new series), April, 1893.—Condition of Winter Grain; Notes Concerning Wheat from Reports of State Agents and County Correspondents; Condition of Farm Animals; European Crop Report for March, 1893; Freight Rates of Transportation Companies.

Report No. 6, (miscellaneous series) January, 1893.—Rice: Its Cultivation, Production, and Distribution in the United States and Foreign Countries, with a chapter on the Rice Soils of South Carolina.

WEATHER BUREAU:

Bulletin No. 8.—Report on the Climatology of the Cotton Plant.

Monthly Weather Review, January, 1893.

Monthly Weather Review, February, 1893.

APRIL, 1893.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 41, December, 1892.—Some Diseases of Cotton.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ARIZONA:

Bulletin No. 7, February, 1893.—Cañaigre.

Bulletin No. 8, March, 1893.—Cattle Feeding.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:

Bulletin No. 24, February, 1893.—Variations in Milk.

Bulletin No. 25, April, 1893.—Field Experiments with Corn, 1892.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Fifth Annual Report, 1892.

Bulletin No. 43, March, 1893.—Field Experiments with Corn; The Sugar Beet in Indiana.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 21, February, 1893.—Report of Results for 1892, at Calhoun.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 17, June, 1892.—Strawberries and Seed Potatoes.

Bulletin No. 18, October, 1892.—Sweet Potatoes.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Tenth Annual Report, 1892.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Fifth Annual Report, 1892.

Meteorological Bulletin No. 51, March, 1893.

Bulletin No. 21, April, 1893.—Report on Fruits.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 90, February, 1893.—Vegetable Tests.

Bulletin No. 91, February, 1893.—Two Plants for Sandy Land—Spurry (*Spergula arvensis*), Flat Pea (*Lathyrus silvestris*).

Bulletin No. 92, March, 1893.—Small Fruit Notes; Spraying.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:

Bulletin No. 26, January, 1893.—Digestion Experiments with Cows and Pigs.

Bulletin No. 27, February, 1893.—The Composition of Fodders, Wheat, and Milled Products; The Composition of Dairy Products; Sugar Beets.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 50, March, 1893.—The Bud Moth.

Bulletin No. 51, April, 1893.—Four New Types of Fruits.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 88, January, 1893.—Fertilizer Analyses and the Fertilizer Control.

Bulletin No. 88*b*, February, 1893.—Fertilizer Analyses and the Fertilizer Control.

Bulletin No. 88*c*, March, 1893.—Fertilizer Analyses and the Fertilizer Control.

Bulletin No. 88*d*, March, 1893.—Meteorological Summary for North Carolina, January, 1893.

Bulletin No. 89*b*, March, 1893.—Meteorological Summary for North Carolina, February, 1893.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 46, December, 1892.—Underground Insect Destroyers of the Wheat Plant.

OREGON AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 24, March, 1893.—Potatoes; Roots.

Bulletin No. 25, April, 1893.—Codling Moth and Hop Louse; Gophers and Moles.

THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 22, January, 1893.—Tests of Dairy Apparatus.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 22, February, 1893.—Strawberries.

TEXAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 25, December, 1892.—Texas Soils; A Study of Chemical Composition.

Fifth Annual Report, 1892.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:

Bulletin No. 18, February, 1893.—Ladoga Wheat.

ONTARIO AGRICULTURAL COLLEGE EXPERIMENT STATION:

Bulletin No. 87, March, 1893.—Remedies for Common Plant and Insect Foes.

Bulletin No. 88, April, 1893.—The Making of Cheese.

EXPERIMENT STATION RECORD.

VOL. IV. JUNE, 1893. No. 11

For the past ten years a series of experiments in potato culture has been carried on in France under direction of M. Aimé Girard,* which has attracted increasing attention and given promise of wide results. These experiments are interesting, not only on account of the methods used and the results obtained, but especially because they illustrate and enforce certain general principles which should control the management of field experiments. M. Girard was first of all deeply impressed by the fact that the average yield of potatoes in France was far below that of Germany. A little study soon convinced him that this difference was not due to any inferiority in the soil and climate of France, but rather to the careful methods of culture which prevailed in Germany. Recognizing the great economic importance of the potato crop, he saw that it was worth while to bestow a large amount of time and energy on an attempt to find methods of culture especially adapted to France. The improvement of this crop seemed to him an object worthy to engage his best scientific and practical thought. Under this impulse M. Girard set himself patiently to work in his laboratory and garden to study the potato plant and the requirements for its successful culture. He made chemical studies with special reference to the starch content of the tubers, he observed the habits of growth of the plant, he tested numerous varieties, he tried different systems of culture and manuring. All details of work were carefully planned and scrutinized. As far as practicable, uncertain conditions were eliminated at this stage of the investigation. The work was done on a comparatively small scale so as to be under the direct observation and control of the investigator. It was only after five years spent in this careful and elaborate research that M. Girard ventured to put his re-

* Compt. rend. 108 (1889), pp. 412–415, 525–527, 602–604; 110 (1890), pp. 176–179; 111, (1890), pp. 795–797, 957–960; 116 (1893), pp. 651–653; Ann. Agron., 1889, pp. 327–333; 1890, p. 241; 1891, pp. 136–139; Ann. Sci. Agron., 1892, pp. 250–301; Bul. Soc. Nat. Agr., 1889 and 1890; Recherches sur la culture de la pomme de terre industrielle et fourragère, Paris, 1889, pp. 139.

sults into systematic form and to invite the coöperation of potato growers in testing their practical application. At first he very wisely confined this coöperative work within a very small circle of experimenters. Even then he encountered the difficulty common to such efforts. Some of the experimenters did not think it worth their while to exactly follow his directions. Their results as compared with those obtained by the more obedient and faithful workers were so much poorer as to afford a very impressive object lesson of the importance of attention to details in high farming. Encouraged by the general outcome of this first season of coöperative work, M. Girard has gone on gradually increasing the number of experiments and the size of the experimental plats until, in 1892, some six hundred growers in different parts of France undertook experiments under his direction. In some cases the experimental fields covered more than 100 acres. The results, in general, have shown that even in relatively unfavorable seasons it is possible by careful methods of culture to raise the average yield of potatoes in France from 150 to 500 bushels per acre, and at the same time to materially increase the starch content of the tubers.

The general features of the system adopted by M. Girard are the choice of a soil of good quality, a deeply-worked seed bed, a complete fertilizer with constituents carefully adjusted to the needs of the soil, planting at a favorable time in rows with regular spacing, the use of whole seed tubers of average size from plants which had a vigorous growth of tops, cultivation which keeps the growing tubers constantly covered, preventive treatment for fungous diseases, and harvesting after all the foliage has withered. Richter's Imperator is the variety found to be best adapted for general use in France, having a high starch content and giving large yields under careful culture.

While M. Girard has recently devoted much attention to directing coöperative experiments, he has not given up scientific investigations on the potato plant, but is still seeking to discover ways for improving his methods of culture, based on experiments and observations in the laboratory and plant house. The details of his work, as given in the publications cited, are well worth the study of experimenters and farmers, but aside from any practical adaptation of the methods and results of this investigation to potato culture in this country, the lessons to be derived from it should be an inspiration to good work in field experimenting. A careful choice of a sufficiently important subject of research, wise and patient work in private until definite results are obtained, a matured plan for coöperative experiments, restriction of the coöperative work within limits which make competent supervision practicable, gradual extension of coöperation until the needs of different localities are met, the continuation of scientific research to improve methods already found to be practically useful—these are the things for which we commend M. Girard and which we urge upon the attention of those who make and those who criticise field experiments.

The text of the fourth volume of the Experiment Station Record is completed with the present number. A classified table of contents and a full index to this volume will be issued as usual, and will constitute the twelfth number of the volume. The list of abstracts includes 296 bulletins and 25 annual reports of the stations, 71 publications of this Department, and 190 foreign articles. The space devoted to the titles of articles in foreign publications has been materially increased and, in general, wider scope has been given to the review of foreign literature. Original articles by eminent specialists in different lines has been a new feature in this volume, which it is hoped to continue hereafter. Much progress has been made by the Office during the past year in establishing relations with the foreign stations. A considerable number of their reports are now regularly received and information regarding their work is cheerfully given through correspondence. There is evidently a growing desire for coöperation in receiving and utilizing such information as the station workers in different countries have to give. It is the aim of this Department to make the Office of Experiment Stations a bureau of information regarding the operations of the 320 experiment stations of the world, with the belief that a free exchange of thought on the science and practice of agriculture will be of great benefit to the people of all nations.

THE OBJECT AND METHODS OF SEED INVESTIGATION AND THE ESTABLISHMENT OF SEED-CONTROL STATIONS.*

DR. OSCAR BURCHARD.

THE DETERMINATION OF THE GERMINATING POWER.

The testing of the germinating power of seed is of great importance. The capacity of seed to germinate is influenced in a very large degree by a number of conditions, such as the weather during growth, the condition in which the crop was gathered, and the way in which the seed has been kept. Furthermore, the estimation of the germinating power from external appearances, especially in the case of the smaller kinds of seeds and the seeds of trees, is even less easily feasible than the estimation of the grade of purity.

The time required for a test of germinating power varies with the kind of seed. The process is divided into three successive operations:

(1) The counting of a certain number of grains for the test. These are so selected as to represent as accurately as possible the average character of the whole lot.

(2) Soaking the seeds from six to fifteen hours in pure water and then placing them in the medium in which they are to be germinated.

(3) A careful watching during the process of germination and the closing of the test at the end of a specified period.

Counting the seeds.—The grains selected for germination are counted out either from the "pure seed" (*b*) of the "smaller average sample," described on page 796, or directly from the large sample as received. In the latter case naturally all those constituents which are removed as "foreign admixtures" in the test of purity must be rejected. Care is to be taken, furthermore, that the genuine seeds which have been counted out should correspond accurately to the genuine seeds of the original sample; that is to say, the variations in the size, color, and development of the grains should be represented as closely as possible.

Differences in the color of seeds are sometimes occasioned by different degrees of ripeness or by other accidental circumstances, which affect their capacity for germination. For example, pine seeds always contain a small percentage of light-yellow grains in addition to the normal dark-brown ones. The writer has determined the germinating

* Continued from page 801.

power of selected light-yellow seeds from a number of specimens of pine seed, and at the same time that of the whole sample. The light-yellow seeds showed, on the average, only half the germinating capacity of the whole sample; and in an average sample, at the end of the experiment, there were three times as many imperfect grains among the light-yellow seeds as in the whole sample.

The results of the test are given in the table herewith:

Germination tests of seeds of pine.

Laboratory number.	Percentage germinating in— 10 days.		Percentage germinating in— 28 days.		Percentage of imperfect seeds in average sample.	
	Whole sample.	Light-yellow seeds.	Whole sample.	Light-yellow seeds.	Whole sample.	Light-yellow seeds.
I	55.33	35.33	57.50	38.00	6.83	21.33
II	59.60	28 00	62.70	31.33	9.30	25 33
III	58.33	21.00	60.67	22.50	12.00	44.00
IV	66.50	38.00	70.33	41.50	6.83	17.50
V	63.67	7.50	66.83	22.50	9.00	18 00
VI	56.33	45.50	65.67	49.50	0.17	12.00
VII	61.17	32.50	64.00	34.50	4.50	14.00
Average	60.13	29.69	63.96	34.26	6.95	21.81

It is clear, then, that the ratio of the light seeds to the total quantity taken for the germination test must not be left out of account.

In case of most of the *Leguminosæ*, as will be noted in detail beyond, a portion of the seeds do not imbibe water, and on this account can not germinate. The percentage of such impervious grains is very variable. The proportion in a given lot depends upon soil, weather, and other conditions.

Since most of the clover seed in the market is a mixture of seeds of the same kind but from different sources, and on this account of various degrees of ripeness, shades of color, and size of grains, the result of a germination test would be incorrect unless the color and size of the counted seeds were representative of the whole sample.

In tests of grass seeds the process should be modified in one way, namely, in taking care to remove the imperfect seeds before placing in the germinating apparatus or medium. The imperfect seeds are detected in the same way as in the determination of purity; that is to say, in the larger kinds of seeds by the feel, and in the smaller and more tender varieties by examination on a glass plate illuminated by light from a mirror. Or the examination can be made with greater certainty by soaking the seeds and counting those which become transparent and rejecting the imperfect ones.

It is very advantageous in the examination of *Alopecurus*, *Holcus*, *Anthoxanthum*, etc., to combine the germination test with that for purity, as proposed by Nobbe. To do this two small weighed portions of the sample are freed from foreign admixtures and placed in the

sprouting bed. At the first examination the imperfect seeds are removed from the bed, dried, and their weight added to that of the foreign admixtures while the germinating capacity of the perfect grains which remain is determined. In case of *Holcus* and *Anthoxanthum* the outer husk may be removed by gentle rubbing and the grains with only the inner husk remaining may then be tested for germinating power.

The number of seeds to be selected depends upon the length of the experiment. Naturally seeds which germinate slowly are much more exposed to the disturbing action of microörganisms than those which germinate rapidly and are finished in ten days, for example. On this account it is necessary to neutralize the variations and irregularities by a large number of trials. Of the larger and firmer seeds (*Quercus*, etc.) only a small number are required. The control stations belonging to the Association of German Experiment Stations have decided upon the following numbers of duplicate or triplicate samples: Two samples each of 200 grains of clover and other easily germinating seeds; three of 200 grains of *Coniferæ*, grass seeds, etc.; three of 100 grains of *Beta;* two of 100 grains of *Quercus*, *Fagus*, etc.

Soaking.—Each sample of 200 or 100 seeds is placed in a beaker and a considerable quantity of distilled water added. The seeds are then allowed to soak from six to fifteen hours. The soaking softens the outer seed-coat (testa) and thus accelerates the germination process. It is well to begin the soaking in the morning or evening, so that the soaked seeds will be ready to be placed in the sprouting bed at the close or beginning of the working day.

Transfer to sprouting bed.—The process of transferring the soaked seeds to the germinating medium is as follows: A funnel 10 to 12 cm. in diameter is covered with gauze and placed in a glass cylinder 8 to 10 cm. in diameter and 30 to 40 cm. in height. The contents of the beaker are then emptied upon the gauze, which is pressed downward a little into the funnel, and the beaker rinsed until all the grains are removed to the gauze. The seeds thus collected in the funnel are then carefully spread in the moist germinating medium with a horn spatula.

Sprouting bed.—(1) For the germinating medium or "sprouting bed" folds of heavy filter paper, doubled, are specially to be recommended. The size is regulated by the size and number of the seeds. Two or three of the folds are placed in a clean porcelain dish with two thicknesses of filter paper on the bottom. They are likewise covered with two thicknesses of filter paper. To each fold is attached a tag with its number in Roman numerals. The dish itself is marked by a gummed label.

(2) Other forms of germinating apparatus are often used. Among them Nobbe's earthenware apparatus (Fig. 3) is specially to be mentioned. The seeds are placed in the dish *A* in the circular depression (*a*) which is surrounded with a circular channel (*b*) filled with water.

The cover *B* is somewhat larger than the dish *A* and rests upon four supports at the corners, thus allowing a free circulation of air between the two parts of the apparatus. The opening (*d*) may be used for the insertion of a small thermometer.

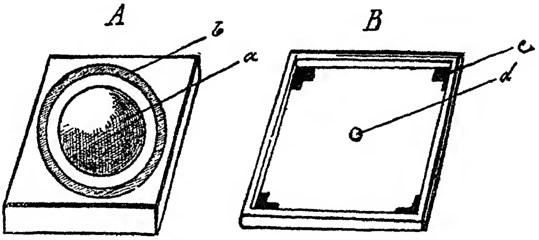

FIG. 3.—Nobbe's germinating apparatus.

For sprouting beds in comparative tests various other media are to be recommended; among these are earth and sand.

(3) Soil is especially good for the germinating medium for comparative tests of fine grass (*Poa*, *Agrostis*, etc.) and forest seeds. For this, small clean earthenware pots are filled with fine sifted garden soil, which has been sterilized to kill any seeds which it might contain and to destroy molds. When ready for use the soil is moistened, and the seeds which have been previously soaked in a little water are placed carefully upon it. The soil acts as a filter and retains the seeds at the surface. The pot is then covered with a disk of double filter paper and placed in a second vessel, the bottom of which is covered with water, so that the surface of the soil remains uniformly moist.

(4) For the sand sprouting bed a porcelain dish with perpendicular sides is nearly filled with sterilized sand, to which 25 per cent of water is added. The seeds are placed upon the surface of the sand. If the apparatus is placed in the moist atmosphere of a germinating chamber a cover is hardly necessary. The apparatus can be kept either in a germinating chamber, as described beyond, or in a thermostat and the temperature maintained at 20° C. (68° F.) The moisture is controlled by daily examination, and water is added as necessary.

Paper sprouting beds are moistened two or three times daily. Too much moisture is injurious, especially for delicate grass seeds. The filter paper should be barely saturated with water.

Temperature.—For the determination of the germinating power of clover and other *Leguminosæ*, and numerous grasses likewise, such as rye grasses (*Lolium*), timothy, orchard grass, etc., a constant temperature of 20° C. (68° F.) should be maintained, which, as practical experience shows, will induce a normal germination process in seeds capable of germination. Liebenberg and others have observed that a much larger percentage of the seeds of certain kinds of grasses, as *Poa*, *Agrostis*, etc., germinated when the temperature was periodically raised above 20° C. Light, on the other hand, is very detrimental to the germination process.

The results of tests of the germinating power of various kinds of seeds at 20° C. during the whole period, and when the temperature was

raised to 30° C. (86° F.) for a period of six hours each day are given in the following table:

Effect of a periodic rise of temperature on the germinating power.

Kind of seed.	Germinating power at—		Kind of seed.	Germinating power at—	
	20° C., constant.	30° C., six hours daily.		20° C., constant.	30° C., six hours daily.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
Poa pratensis	0.83	38.00	*Poa compressa*	0.67	55.00
Do	7.33	40.17	*Agrostis alba*	64.17	96.00
Do	0.07	49.67	Do	65.83	96.33
Do	2.67	53.17	*Phalaris arundinacea*	33.67	56.00
Do	0.12	40.67	*Alopecurus pratensis*	42.50	83.67
Do	4.83	77.67	Do	67.33	84.50
Poa nemoralis	20.67	48.00	Do	66.00	81.33
Do	35.17	67.83	*Morus alba*	42.17	93.00
Poa annua	75.87	84.67	*Morus nigra*	21.17	61.83

A constant temperature of 30° C. is more or less detrimental to the germination of the majority of grass seeds.

In accordance with the action of the Association of Agricultural Experiment Stations in the German Empire, the following kinds of seeds are kept six hours daily at a temperature of 30° C. in a separate thermostat: *Agrostis*, *Aira*, *Alnus*, *Alopecurus*, *Phalaris*, *Beta*, *Betula*, *Glyceria*, *Daucus*, *Morus*, *Nicotiana*, *Poa*, and *Zea*.

Since the question as to how far the intermittent raising of the temperature corresponds to the conditions of daily and nightly temperature of seeds germinating in ordinary soils is not yet decided, for the present only the results of tests of germinating power made at a constant temperature of 20° C. are included in the reports of the tests.

Examinations during the process of germination.—The periodical examination of the germination experiment is conducted as follows: The sprouting bed is inspected from day to day, and the seeds which have germinated are removed, counted, and entered in the schedule as below, the time being reckoned from the commencement of the soaking. At the same time the seeds or germinating plantlets which have a dark color at the points of the rootlets or a decomposed or unsound appearance are taken out and counted as decayed.

It is not necessary to make an examination every day, although inspections made as often as possible facilitate the following up of the process of germination.

Since the age of the seeds very materially affects the rapidity of germination as well as the absolute germinating capacity, another factor, germinating energy, must be taken into consideration. By this term is meant the percentage of seeds which germinate during a certain short period (see below), the length of which is naturally regulated by the kind of seed. An examination is made at the end of this period as well as at the beginning of the germinating process.

Specimen schedule for test of germinating power.

Register number.	Kind of seed.	Date of — Soaking.	Date of — Transfer.	Sprouting bed.	Duration of the germination test in days, and number of seeds germinated. — 1	2	3	5	7	10	13	14	Germinating power. — Total.	Average.	Per cent.	Impervious.	Decayed.	Germinative energy.
		March.																Per ct.
1000	*Lolium perenne*	1	1	I	..	..	40	81	24	16	4	..	165			......	35	
	Do	...	....	II	..	..	39	86	21	15	2	1	164	161	80.5	......	36 } 19.5	60.7
	Do	...	....	III	..	...	42	76	19	16	1	..	154			......	46	
1001	*Trifolium pratense*	1	2	I	..	161	19	5	2	..	..	..	187	187.5	93.75	12 } 5.75	1 } 0.5	90.0
	Do	...	....	II	..	162	18	6	1	1	..	..	188			11	1	

[Thus for the *Lolium*, numbered 1000 in the laboratory register, three portions of 200 grains each were taken, in accordance with the rule adopted by the German stations (see page 797), and after soaking were placed in the sprouting bed. The experiment was continued for fourteen days for test of germinating power, but the estimate of germinative energy was based upon the number of seeds germinated at the end of five days (see page 888). The average number of seeds germinated in fourteen days was 161, or 80.5 per cent. The germinating power is accordingly 80.5 per cent. The numbers germinated at the end of five days were 121, 125, and 118, respectively. The average was 121.3, which gives 60.7 per cent as the measure of the energy of germination.—Ed.]

After a stated period, varying also with the kind of seed, the germination experiment is brought to a final close and the average percentage of seeds which have germinated is ascertained. The seeds which have not yet germinated are then subjected to still another trial. In tests of seeds of *Leguminosæ* the seeds which have not imbibed * water are counted, and the result noted and expressed in percentage. The decayed seeds are registered in the same manner.

Seeds of trees, on the other hand, are subjected to an average test, which shows the percentages of (1) imperfect seed, (2) seeds apparently still fresh, and (3) decayed seeds.

Many seeds, as *Pinus strobus*, etc., germinate so slowly that, after months even, a larger or smaller percentage remains inert, but will germinate if the test is continued. On this account it is important to note the number of seeds which at the end of a stated time (forty-two days) present a perfectly fresh appearance when cut open, since their germinating capacity is highly probable even if not actually proven. They are to be entered in the category of the impervious seeds, *i. e.*, those not imbibing water.

Accurate and long-continued researches show that only a very small proportion of the impervious seeds of the *Leguminosæ* germinate in the course of a year. On this account it would be incorrect to designate

* The seed of most of the uncultivated *Leguminosæ*, and also those of certain cultivated legumes which are not entirely domesticated but still half wild, usually contain a large percentage of grains with impervious seed-coats.

these hard grains as either entirely or even to a certain extent capable of germinating. Moreover, any such assumption would be only hypothetical, since different kinds of seed behave differently in this respect. Hence, only the germinating power as actually found is to be taken into account in forming an estimate of the "intrinsic value" of the seed, although the number of impervious grains should be stated.

The Association of Agricultural Experiment Stations in the German Empire has adopted the following periods of days for determining the energy and the power of germination of different kinds of seeds:

Kind of seed.	Germination— Energy.	Germination— Power.
	Days.	*Days.*
Cerealia, Trifolium, Lathyrus, Pisum, Vicia, Lens, Brassica, Lepidium, Sinapis, Camelina, Papaver, Linum, Cannabis, Nicotiana, Cichorium, Spergula, Helianthus	3	10
Cucumis, Cucurbita, Faba, Lupinus, Poterium, Spinacia, Polygonum	4	
Lotus, Ornithopus, Althæa, Beta, Phleum, Lolium, Phalaris, Festuca pratensis	5	14
Daucas, Fœniculum, Anthriscus, Onobrychis, Sorghum	6	
Agrostis, Aira, Glyceria	6	21
Anthoxanthum, Phalaris, Deschampsia, Trisetum, Dactylis, Holcus, Festuca ovina, F. rubra, Alopecurus, Pimpinella, Morus	7	
Cynosurus, Poa, Alnus, Picea, Betula, Quercus, Fagus	7	28
Pinus sylvestris, Abies, Acer	10	
Pinus strobus, P. cembra, P. austriaca, Pomaceæ	14	42

For seeds which grow in clusters with varying numbers of seeds joined closely together, as, for example, beet, *Poterium*, etc., the method of determining the germinating power must be somewhat modified. After the close of the germination experiment the total number of the seeds which were present in the clusters must be determined by an "average test," and the number of germinating plantlets be referred to this total number of seeds for estimate of percentages. The number of the germinating plantlets is obtained as follows:

Each of the 100 clusters of a sprouting trial which has produced 1, 2, 3 or more germinating plantlets either at the same time or successively, is removed from the original bed at the time of the first examination. The germinating plantlets are then cut out with a sharp knife and the clusters placed in a special bed whose number corresponds to the number of germinating plantlets already produced by the cluster. If, at the next examination the cluster is found to have produced one or more new germinating plantlets, these are removed as before, and the cluster is transferred to a bed which bears a higher number, equivalent to the total number of plantlets which the cluster has produced. The examinations are made on the third, fifth, eighth, and eleventh days and the test is closed on the fourteenth day. The sums of all the plantlets of the clusters of each bed are added together. The average of all the clusters is accurately made up, and especial care

is taken that no cavities which were empty at the beginning be counted as seeds.

With different kinds of beet seed both the number of seeds in the clusters and the size of the clusters themselves differ very widely; and, furthermore, in some lots large and in others small clusters predominate. Hence it is convenient to refer the number of germinated seeds to one gram of the clusters. For this purpose the average weight of each 100 clusters and also the weights of two lots of 1,000 clusters are determined. From the average of these 2,300 clusters the number of germinated seeds per gram of clusters is calculated. For example, in a trial 100 clusters produced 367 germinating plantlets and 100 clusters weighed 2.23 grams. Hence 1 gram of clusters produced 367 ÷ 2.23, or 164.5 plantlets.

In the selection of the clusters for the test the greatest possible care should be taken that they represent the character of the sample.

Calculation of the intrinsic value.—The intrinsic value of a sample of seed is expressed by the percentage of grains capable of germinating which are contained in the pure seed, the weight of which is also expressed in percentage. For example, let R equal the percentage of purity and K the percentage of germinating power, then $\frac{R \times K}{100}$ represents the intrinsic value of the sample. This item is included in the report of the investigation.

ADDITIONAL TESTS OF THE VALUE OF SEEDS EMPLOYED BY THE SEED-CONTROL STATIONS.

In addition to the intrinsic value of a given lot of seed for sowing as thus determined, still another set of factors are to be taken into account, namely:

(1) *The genuineness of the species, i. e., whether the seed is "true to name."*—With the exception of a few rare grasses and other species, almost any kind of ordinary agricultural seeds may be distinguished from others by sufficiently careful examination of the grains. But the external similarity of seeds of different species or varieties makes very easy the substitution of other and generally less valuable kinds, so as to deceive the careless or inexpert buyer. Even to-day we sometimes find the worthless "wavy" or "flexuous" hair grass (*Aira flexuosa*) in place of the valuable yellow oat grass (*Trisetum* [*Avena*] *flavescens*), the totally unproductive *Poa compressa* in place of *Poa pratensis*, and *Agrostis capillaris* in place of *Agrostis alba*, var. *gigantea*. Still other substitutes come into market with such names as "blue grass" and "fiorin grass," which do not frighten buyers. In fact, substitutes consisting in large part or entirely of worthless forest and shade grasses are offered under the names of valuable meadow grasses. In addition to the characteristic appearance of the seed itself, such substitutes are characterized by the presence of seeds of certain accompanying varieties of forest and shade plants which do not grow in meadow lands.

I would call special attention to the peculiar fraud in the "Chili lucern." The seed which comes into market under this fine-sounding name is nothing more nor less than the residue from the washing of wool, and is composed mostly of *Medicago denticulata*, *M. hispida*, and *M. maculata*, with other seeds whose prickly envelopes are caught by the sheep at pasture and remain tangled in the wool. Hundreds of pounds of this seed material, containing only annual and not perennial kinds of lucern, is obtained from the washings of the wool of South American, Australian, and East Indian sheep. It usually contains steel teeth from the cards which are used in carding the wool. If a sample of such seed is spread out and a magnet passed through it, a great number of these teeth, about 1 cm. in length, will be found. These give abundant proof of the character of the seed. Furthermore, the size and shape of the seed are so characteristic that it is very easy to distinguish between this and cultivated lucern.

(2) *The genuineness of the variety.*—Only in rare cases can the variety of a kind of seed be distinguished by the kernel itself. In other cases this must be decided by a field test. Differences of variety in the smaller kinds of seeds are the least possible to distinguish. This is very difficult with varieties of *Brassica*—for example, *Brassica rapa*—but relatively easier with the larger kinds of seeds, as the *Leguminosæ* (*Pisum*, *Phaseolus*, *Faba*, etc.), and the cereals. The use of microscopic sections is almost always essential, and in all cases comparison with a large collection of standard specimens of seeds is absolutely necessary.

The above and likewise the following questions are among the most difficult tasks demanded by seed control, and they can be solved only with the aid of abundant use of the literature of the subject, thorough knowledge of botany, and large experience.

(3) *The origin of the seed.*—If the farmer wishes to obtain a good yield it is of great consequence that the seed which he sows upon his land shall have been grown under similar climatic conditions and such as are not in a marked degree unfavorable. It is therefore important to discriminate between seeds from different sources. Neither color, size, nor shape is a sure means for telling the source, but the kinds of seed which occur incidentally in a given sample are indicative of its origin. This means that a botanical analysis should be made of the weed seeds. For instance, if a sample of seed contains weed seeds which are geographically localized, or seeds of such plants as ripen very late in northern or high latitudes, it is fair to assume that the seed originated in a particular locality or a southern latitude, as the case may be. A preponderance or the isolated occurrence of such weed seeds will, when the other foreign seeds are taken into account, serve to indicate whether the entire sample or only an admixture belongs to a given locality.

In general, it is not a difficult matter to determine the continental origin of seeds, *e. g.*, whether they are European or American. In Ger-

many the detection of the American variety of red clover, which is largely imported, and which is characterized by long and thick hairs, has been developed into a definite method.

The regular occurrence of highly characteristic kinds of seed in American red clover, and among them those of plants specifically American, which have not been observed to ripen at all in middle Europe—or, at least, not within the period in which clover becomes matured for cutting—furnishes a series of infallible indications of the origin, especially as they are in sharp contrast to the numerous specifically European weed seeds, which are also highly characteristic. Almost every lot of red-clover seed from the United States is found to contain, even when thoroughly purified, varying quantities of the following seeds: *Amaranthus retroflexus*, *Ambrosia artemisiæfolia*, *Anthemis cotula*, *Chenopodium album*, *Cuscuta racemosa*, *Euphorbia* sp. *americana*, (*Echinochloa*) *Panicum crus-galli*, (*Digitaria*) *Panicum filiformis*, (*Digitaria*) *P. sanguinalis*, *Lepidium virginicum*, *Panicum capillare*, *Phleum pratense*, *Plantago aristata*, *P. rugelii*, *Polygonum persicaria*, *Rumex acetosa*, *R. acetosella*, *Setaria glauca*, *S. viridis major*, *Specularia perfoliata*, *Teucrium canadense*, and *Verbena urticæfolia*.

Specifically American seeds are never found in European clover seed, but in their stead the following varieties occur:

Anagallis arvensis, *Anthemis arvensis*, *Chrysanthemum segetum*, *Cichorium intybus*, *Cuscuta trifolii*, *Daucus carota*, *Echium vulgare*, *Geranium palustre*, *Plantago lanceolata*, *Polygonum lapathifolium*, *P. aviculare*, *P. convolvulus*, *Melandium album*, *Lampsana communis*, *Brunella vulgaris*, *Pyrethrum inodorum*, and *Sherardia arvensis*.

Both American and European weed seeds are so characteristic, and American seeds contain the former in such quantities, that even mixtures of American with European seeds may be distinguished by means of them. In this connection it should be specially noted that not the occurrence of a single species of seed, and far less that of a single grain of a kind, can prove anything in itself, but that the total evidence must be weighed before a just conclusion, as regards the origin of the sample, can be reached. The relative amounts, as well as the total number of foreign constituents, should also be taken into consideration.

The weed seeds found in the grass seeds of both continents are in part alike, but may be distinguished by well-known varieties. The following have been frequently observed in American orchard grass: *Poa* and timothy seed, *Paspalum stoloniferum*, *P. ciliatifolium*, *Rubus idæus*, *Potentilla* sp. *americana*, *Carex* sp., etc. European grass seed very often contains *Anthriscus sylvestris*, *Carum carui*, *Crepis virens*, *Gallium mollugo*, *Myosotis stricta*, *Potentilla argentea*, *Ranunculus acer*, *R. sceleratus*, *Salvia pratensis*, *S. verticiliata*, *Trisetum flavescens*, *Vicia tetrasperma*, *V. hirsuta*, *Trifolium campestre*, etc.

The investigation and determination of the origin of seeds from dif-

ferent sections of the same general division of the world is more difficult, but even here there are numerous points which make a distinction possible. The distinction between southern European and Russian seeds has been drawn with fairly good success by means of the regular occurrence of characteristic weed seeds* and doubtless the same methods will apply to distinguish seeds from Canada and the Atlantic States from those of the more central and southern sections of the United States.

Investigations on the subject have brought out a number of indications by means of which it is possible to distinguish between the seed of North and South American red clovers and lucerns. Although *Ambrosia*, *Plantago rugelii*, and *P. aristata* appear to be absent from South American seeds, other varieties, all of which are not yet fully described, may be mentioned, namely: *Bidens chrysanthemoides*, *Nicandra physaloides*, *Calandrinia umbellata*, *C. procumbens*, *Cuscuta chilensis*, *Melilotus elegans*, *Amarantus* sp., *Helianthus annuus*, *Centaurea sulphurea*, *Fumaria* sp., etc.

(4) *The absolute weight of the seeds.*—A large and fully developed seed grain supplies the germinating plantlet with an abundance of food and insures a thrifty development. For this reason alone a high weight of the seed grains to be sown is desirable, leaving out of account the fact that this property is also indicative of a variety which has been well developed by cultivation. To determine the average weight per grain, two or three samples of 1,000 grains, each representing the character of the whole sample as closely as possible as regards size, are weighed (in grams) separately. The average of the weighings gives the average weight of the grain of seed (in milligrams). In the selection of the grains the greatest care should be taken that all possible portions of the sample be represented.†

The envelope which surrounds the caryopsis of *Gramineæ* often constitutes a comparatively large part of the weight of the seed. With oats this factor is quite important. The better kinds have a lighter husk than the poorer ones. Its weight is obtained by removing the husks from a weighed quantity of average grains by means of forceps with roughened points. The weight of the husks is referred to that of the whole seeds.

(5) *The weight of a known volume of seed.*—The larger kinds of seed, especially cereals, have been tested since time immemorial by weight

*Southern European seeds are characterized by the occurrence of *Cephalaria transsylvanica*, *Helminthia echroides*, *Arthrolobium scorpioides*, *Centaurea sulphurea*, *C. paniculata*, *Lactuca perennis*, *Crepis biennis*, *Hibiscus trionum*, *Hyoseris scabra*, etc.; while Russian seeds contain several kinds of *Cirsium*, *Anthemis tinctoria*, *Hyoscyamus nigra*, *Nigella arvensis*, *Dracocephalum thymiflorum*, *Silene dichotoma*, *Berteroa incana*, *Barbarea vulgaris*, and many others.

† In his "*Handbuch der Samenkunde*," p. 500, Prof. Nobbe gives the average weight per grain of different seeds, obtained by weighing a great many samples of the same kind of seed.

of a given volume. From the physical standpoint this means the weight of the grains which will fill the "unit of volume," but accurate investigations have shown that this quantity depends upon the resultant of a number of variable properties, partly external and partly internal, of the grain itself. The determination can be made by either of two mehods, namely, measuring the space which a weighed quantity of grain fills, or weighing the unit of volume (1 liter) of the seed. Of late the latter method is more commonly practiced.

Forms of apparatus all based upon the same principle are being continually brought to greater perfection, especially in respect to the accuracy of measurement of the quantity of seed which fills a given unit of volume. The form of the measure is cylindrical and its height and diameter affect the results, as does also the way in which the grain is poured in. The principles on which this apparatus is constructed belong to the province of physics, and their explanation would lead us too far from our subject.

For the sake of uniformity the "Normal weights and measures commission" has devised an apparatus, to be used in the German Empire, by which the weight of a liter of seed can be ascertained.

As regards the use of this method it should be noted that, in pursuance of the action of the Association of Agricultural Experiment Stations in the German Empire, all kind of cereals are to be tested pure—that is to say, free from all foreign admixture. This condition practically excludes the application of the method for the smaller kinds of seeds in which, in the nature of the case, there would be very considerable sources of error. Furthermore, the method of the determination of the weight of a given volume is not adapted to hairy or bearded seeds with rough surfaces. Finally, it is to be remarked that results should be based on the average of at least three weighings.

(6) *Horny and starchy seeds.*—In forming an estimate of many kinds of grain the properties indicated by the terms "glassy" or "vitreous," "horny," and "mealy" or "starchy" must be taken into account. With a large amount of proteid matter deposited in the cells the vitreous, and with less the mealy, structure prevails. The character is ascertained by cutting the seed open.

Forceps may be used in the examination of single grains, but when the percentage of horny and starchy grains is to be found and a large number is required the "farinatom" is used. This apparatus is quadrangular in shape and provided with several interchangeable plates. Each of these plates has four rows of twenty-five holes to receive the grains of seed. The grains are placed perpendicularly in the holes, into which they should sink for half their length. A sharp, three-cornered knife is then passed close over the surface of the plate, the grains being pressed at the same time, so as to hold them in position on the plate. In this way all the seeds are cut in two and their sections

exposed for examination. The grains can then be sorted out as horny or starchy and the results expressed in percentages.

"Horny" kinds of wheat pass as the most valuable, but "starchy"* barley is better adapted to the manufacture of spirits than the "vitreous."

(7) *Color and other external characters of seed.*—These are for the most part of little importance in the estimation of the value. At the same time various external features, such as color and luster, affect the market value of seeds, and frequent attempts are made to produce them by artificial means, and thus to "improve" the appearance of the seed. But, as a matter of fact, such treatment, *e. g.*, the coloring of seeds or bleaching them with sulphur dioxides, as is done with white and scarlet clover, injures the vitality of the seed and thus reduces its intrinsic value. The polishing of seeds with grease is also injurious.

As a rule, artificial coloring is very easily discovered, and treatment with sulphur may be detected by adding pure zinc and sulphuric acid to the aqueous extract from the sample and testing for sulphuretted hydrogen with lead paper.

In cases where the general color of the seed is affected by the presence of green and unripe or old and dark-brown, shriveled grains, this appearance indicates an inferior quality and the intrinsic value of the seed will be found to be affected, but differences in the finer shadings of natural color are a result of climate, seasons, and soil, and are useless as indexes of the value.

THE EQUIPMENT AND APPARATUS OF A SEED-CONTROL STATION.

The equipment required for a seed-control station, including both material outfit and working force, will depend upon the amount of investigation to be carried on. On this account an approximately accurate plan for the work, or at least an estimate of the minimum amount of investigation, should be decided upon at the start and the arrangements made accordingly.

Laboratory rooms and their contents.—For a station with ordinary requirements as regards work to be done, the following rooms are needed:

I.—A commodious, well-lighted working room, with a number of well-lighted working tables. The latter should not have a southern exposure. This laboratory should contain:

(1) A large desk for apparatus supplied with (*a*) filter and glazed paper; (*b*) printed matter, blank forms, etc.; (*c*) clover sieves, horn spatulas, and various smaller utensils; (*d*) miscellaneous apparatus, *e. g.*, apparatus for determination of weight of a definite volume, a chaff separator, an apparatus for accurate separation (see "winnowing machine" beyond), apparatus for shaking clover sieves, various thermometers, and also grain and clover sampling tubes.

* Richer in starch.

(2) Optical instruments and aids, (*a*) one or more microscopes, to be kept in separate cases or a small cupboard; (*b*) an assortment of good lenses* for seed examination.

(3) A repository for empty bottles, glass receptacles for samples which are to be studied, "smaller average samples," selected seed and other substances, and all specimens which are being worked upon.

(4) A standard seed collection in a glass case.† This should contain specimens of seeds of the different species and varieties of the most important cultivated plants, and also other kinds, including especially weed seeds.

This collection may be easily and conveniently set up in the following manner: The various kinds of seed are placed in white glass cork-stoppered bottles, and arranged in systematic order. Each bottle will bear a label showing the name, origin, date of collection, ripeness, etc., of the seed. If the collection is a very comprehensive one it may be placed in a separate room, but on the whole it can be used more conveniently and to better advantage when it is located within easy reach.

(5) The most important literature of the subject.

(6) One or more accurate balances.

The utensils needed for constant use, as forceps, horn spatulas, labels, glazed paper, and a lens, should be kept in a drawer of the working table. One or two large tables upon which samples may be placed when received and various incidental work done are also necessary. A table is very well adapted for the reception of packages of counted and soaked seeds which are to be put in the sprouting beds.

II.—A room with temperature as constant as possible during the whole year. This room may be most conveniently located in the cellar, but should be in direct communication with the working room. In it should be kept the thermostats, which should be in special charge of a competent person. This room should contain:

(1) One or more large germinating chambers, as may be necessary (a detailed description of these is given beyond), and a number of small thermostats (incubators).

(2) Receptacles for the distilled water to be used in the germinating tests. These should be large bottles, conveniently placed, and easily moved. Wash bottles of one liter capacity are used for moistening the germinating media and the seed counted out for soaking.

(3) Other apparatus for regulating temperature and gas pressure.

If the examinations of the germinating seeds are to be made in this room it should be well provided with conveniences for lighting and with

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*Cylinder lenses or at times ordinary reading lenses with a good-sized field are to be recommended for picking out the finer seeds. For the study of single seeds an aplanatic-achromatic lens is absolutely necessary. Such lenses are supplied by Zeiss, of Jena, for $3 each.

† [Standard seed collections can be obtained in bottles, labeled and classified for use, from parties in Germany.—ED.]

working tables, in order to avoid carrying the sprouting beds back and forth.

III.—A room with shelves, on which samples that have been examined are to be placed in the order of the record. The "smaller average sample," *i. e.*, the pure seed (*b*), and the "foreign admixtures" (*c*) (see page 797), and also dodder seed, etc.—should be placed with each sample for convenient reference in case of discrepancy. The samples need not be kept beyond a stated period.

IV.—A room for the director, in which the records, etc., of the station should be kept. Its arrangement should be that of any scientific working room.

It is a very great advantage for the station to be connected with a chemical laboratory or institute. If it engages in physiological research an analytical laboratory is much to be desired. If cultivation experiments are to be undertaken some land is necessary, but for simple experiments a glass extension of the station and the necessary garden implements will suffice.

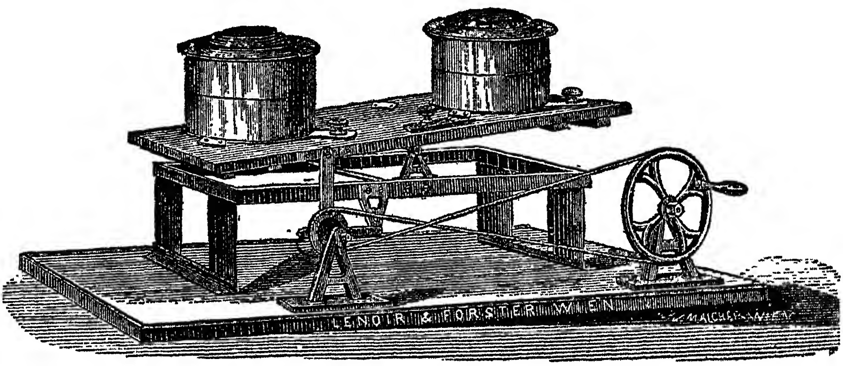

FIG. 4.—Shaking apparatus.

V.—The following forms of apparatus are to be recommended for facilitating the estimation of purity:

(1) *Sieves*.—Those of circular shape made of tin or brass are best adapted to the purpose. The holes should be 2, 1.5, 1.25, 1, 0.5, and 0.25 mm. in diameter. Each sieve should be 5 cm. in depth, and should have a slightly beveled projection on the under side to fit into the top of the sieve below, so that the sieves, when used in series, may fit tightly together. The bottom of the sieve may be closed by a tightly-fitting cylinder of the same depth as the sieve itself. The top is closed by a cover. In this way each sieve may be used separately, or they may be used in series, when it is desired to separate or "fractionate" a mixture of seeds. Three sizes of these (Nobbe's) sets of sieves are in common use. They are 8, 12, and 20 cm. in diameter, respectively, but a larger set of only three pieces, with holes 2, 1.5, and 1 mm. in diameter, may also be had.

The sieves are shaken by hand, a very convenient way being to give them light horizontal impacts against the palm of the empty hand. When several samples are to be shaken at one time, the shaking apparatus made by Lenoir & Forster, of Vienna (Fig. 4), will be found serviceable. The apparatus is adapted to hand power or may be connected with a small motor.

(2) *Chaff separator* (Fig. 5) devised by Nobbe. This consists of a glass vessel, with a cover, and holding inside a smaller, beaker-shaped glass, in which the grass seed containing chaff is placed. A continuous blast of air from a small rubber bellows is directed upon the substance in the inner vessel, and all the lighter constituents are thus blown over the edge, and drop to the bottom of the outer receptacle.

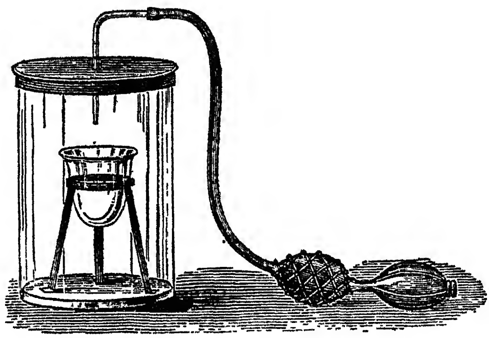

Fig. 5.—Chaff separator.

(3) *Winnowing machine.*—Larger quantities of seed may be handled more easily but less accurately in the apparatus* made by Lenoir & Forster, of Vienna (Fig. 6). This (fanning mill) combines two inclined

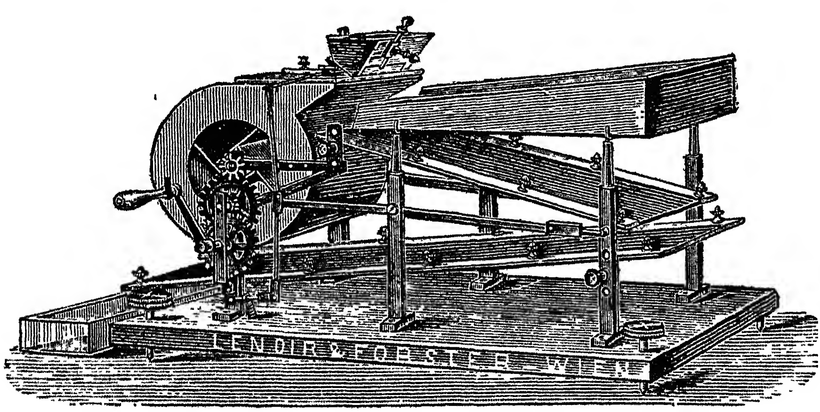

Fig. 6.—Winnowing machine.

surfaces and a rotating fan. A rapid rotary motion is imparted to the fan and at the same time an oscillatory one to the inclined surfaces by turning a crank.

(4) *Balances.*—The determination of purity of many grass seeds and other seeds which contain large quantities of foreign admixtures involves

* In the use of this apparatus the greatest care must be taken that none of the chaff escapes.

a large number of weighings, and besides this there are apt to be times when a specially large amount of weighing must be done. On this account short-arm balances which weigh to 0.5 mg. with the greatest rapidity are recommended. The advantages gained by the quick swing may be further increased by taking the weights of the second and third decimal places directly from the balance beam by the use of a 50 mg. rider, so that no smaller weights than those of decigrams are placed in the pan. The number of balances is regulated by the needs of the station and the number of assistants.

VI.—Apparatus and appliances for determination of the germinating power. Several forms of germinating chambers, thermostats, drying chambers, etc., are employed.

(1.) *Thermostats.*—A form of germinating chamber which is used in the determination of the germinative power of most seeds at 20° C. (68° F.) has given most satisfactory results in the botanical laboratory at Hamburg. It is made as follows:

The chamber is about 1.6 meters in height and 85 cm. in length and width, inside measure. It has a pair of doors on each of two opposite sides. The sides, top, and doors are of wood and lined on the inside with a covering of asbestus 5 mm. thick. The walls are double and the space between them is filled with powdered charcoal, or may be left empty. There are circular openings of about 4 cm. diameter at the top and bottom of the sides of the chamber. Shelves made of galvanized iron rods about 5 cm. apart are supported at perpendicular intervals of 12 cm. by cleats also of galvanized iron, in such a way that they can easily be removed. A Reichart thermo-regulator as improved by Lothar Meyer is placed midway between the top and bottom of the chamber and about 10 cm. from the double door. The principle of the regulator is that the flow of gas is controlled by the top of a mercury column, which is kept in place by ether vapor. This form of regulator is especially to be recommended when the desired temperature is only slightly above that of the surrounding medium. A minimum and maximum thermometer should be supported in a horizontal position near the regulator, so that any irregularities in the working of the latter may be immediately noticed. This germinating chamber is placed in the middle of the room, and has worked admirably, although sometimes in winter the surrounding temperature has sunk as low as 5° C. In spite of this the thermometer has always stood at exactly 20° when the chamber has been opened in the morning.

I also desire to mention a second method for securing a constant temperature, namely, the use of a current of air of a constant temperature. A greater amount of gas is required for this, inasmuch as the removal of the warm air is rather rapid. The cover of the chamber is provided with a chimney tube, at the bottom of which a not too small flame is allowed to burn; this produces a draft of air through the cham-

ber. The air enters the chamber through one or more tubes, which are surrounded by water kept at a constant temperature. The water may be conveniently held in the double bottom of the apparatus and heated by a number of micro-burners.

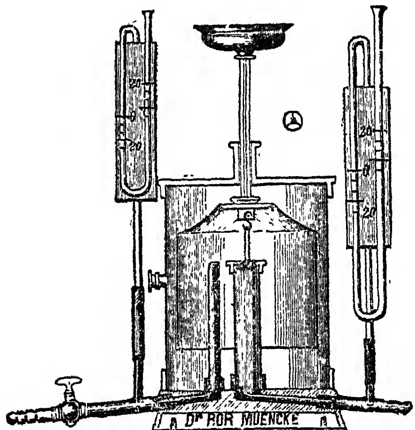

FIG 7.—Gas-pressure regulator.

For smaller thermostats the principle of completely surrounding the space with a layer of water is most accurate. The thermostat of Hueppe with rectangular shelves and a door in front is to be especially recommended for this purpose.

In order to regulate the temperature of the above-described apparatus for a long time constant gas pressure is important. Even the most delicate adjustment of the regulator fails if the gas is subject to considerable fluctuations of pressure, as is sometimes the case in large cities. On this account the gas should be allowed to pass through a gas-pressure regulator before it enters the regulator within the germinating chamber. Such a gas-pressure regulator (Fig. 7) may be procured from R. Muencke, Berlin. If the flame is held at a minimum stand by a separate cock an automatic extinguisher is almost superfluous, unless there is danger that the flow of gas may cease altogether at times. In this case special burners which shut off the gas automatically when the flame is extinguished are to be recommended. Ordinary micro-burners are provided with small mica cylinders which prevent the flame from being extinguished by unavoidable drafts of air.

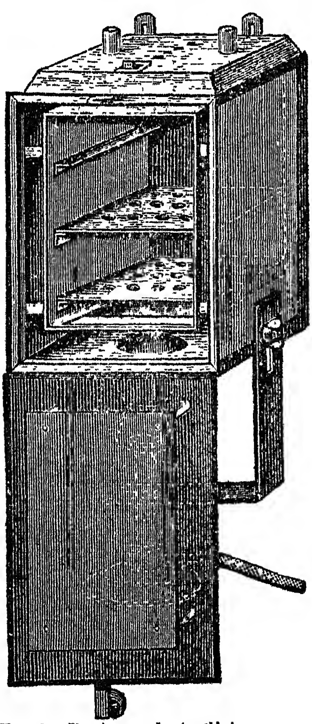

FIG. 8.—Drying and sterilizing apparatus.

(2) *A drying chamber.*—This may be used in determining the moisture content of seeds, and for drying and sterilization in general is indispensable. The form (Fig. 8) in which the actual working space is surrounded by hot air is a convenient one.

DIVISION OF LABOR.

The most advantageous disposition of the expert working force of the seed-control station is attained when each person is engaged in a special line of work. Although all the operations of the seed control, excepting those of a purely scientific nature, are for the most part simple, nevertheless they demand great care and accuracy, and particularly in times of special stress of work a certain amount of cleverness is necessary to insure accuracy and dispatch in the conduct of the processes, which are often very tedious and time-consuming. On this account the various branches of the work of the station should be intrusted to persons especially fitted for them. The seeds for the germinating tests must be counted with the perfect regularity prescribed by the above-mentioned rules, to insure accurate and comparable results, and for this reason it is always best to have the seeds counted by the same individual. In like manner the germinating tests and determinations of purity should each be delegated to a selected person. Weighings and calculations, on the other hand, should be made by specially trained assistants, whose aim is to become specialists in the various departments of botanical work.

In what has been said I believe the essential and important topics connected with seed control have been discussed in a sufficiently exhaustive manner, and the fundamental principles have been set forth upon which a proper and useful exercise of seed investigations may be based.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

METEOROLOGY.

Meteorological summary for 1892, J. FALKENBACH (*Ohio Sta. Bul. No. 47, pp. 249–260*).—Daily and monthly summaries of observations on temperature, pressure, precipitation, humidity, and direction of the wind are tabulated. Means of temperature, humidity, and rainfall, and notes on the weather for ten years are also given. The following is an annual summary for the State: *Air temperature* (degrees F.).—Maximum 103, July 25; minimum —25, January 20; annual range 128; maximum daily range 51, September 25; minimum daily range 1, July 29, November 3, 12, and 28, and December 12; mean daily range 19. *Humidity.*—Mean relative humidity 78 per cent. *Wind.*—Prevailing direction SW. *Precipitation.*—Total rainfall 37.16 inches; mean daily rainfall 0.10 inch; number of days on which rain fell 121. *Weather.*—Number of clear days 111; number of fair days 126; number of cloudy days 129.

FERTILIZERS.

W. H. BEAL, *Editor.*

On the available phosphoric acid and the water-soluble potash in cotton-seed meal, M. B. HARDIN (*South Carolina Sta. Bul. No. 8, n. ser., Dec., 1892, pp. 3–6*).—Determinations by C. W. Sims, F. S. Shiver, and R. N. Brackett, of soluble, insoluble, reverted, and total phosphoric acid and total and soluble potash in 13 samples of cotton-seed meal are tabulated. It appears from the results "(1) that an average cotton-seed meal carrying about 7 per cent of nitrogen (equivalent to $8\frac{1}{2}$ per cent of ammonia) contains nearly $2\frac{1}{2}$ per cent of available phosphoric acid and a little more than $1\frac{1}{2}$ per cent of potash soluble in water; (2) that the available phosphoric acid constitutes over $\frac{9}{10}$ the total phosphoric acid, and the water-soluble potash over $\frac{8}{10}$ the total potash in the meal."

On the occurrence of metaphosphoric acid and pyrophosphoric acid in cotton-seed meal, M. B. HARDIN (*South Carolina Sta. Bul. No. 8, n. ser., Dec., 1892, pp. 10–16*.—Reprint of a paper read before the Asso-

ciation of Official Agricultural Chemists at Washington, D. C., August 25, 1892. (See E. S. R., vol. IV, p. 116.) It was found by direct precipitation of the aqueous extract of cotton-seed meal by molybdic solution that only a small proportion of the soluble phosphoric acid was obtained. Dialyzing the solution or removing the organic matter by means of acetate of lead did not materially increase the amount precipitated. It was found also that a mixture of acid phosphate and cotton-seed meal, which should theoretically give by direct precipitation of the aqueous extract 4.77 per cent of soluble phosphoric acid, actually yielded in duplicate tests 4.80 per cent and 4.82 per cent of phosphoric acid.

[A number of experiments of this kind] seem to show, beyond any reasonable doubt, the presence of both metaphosphoric acid and pyrophosphoric acid in the aqueous solutions of the meals examined. * * * Whether pyrophosphoric and metaphosphoric acid exist in cotton seed or are formed during the preparation of the meal is a point worth investigating.

In conclusion, it is believed that the failure to obtain all the soluble phosphoric acid in a cotton-seed meal by direct treatment with molybdic solution is due not so much to the presence of organic matter as it is to the fact that but a small proportion of the phosphoric acid occurs in the tribasic state.

On the comparative value of different methods of preparing solutions of cotton-seed meal for precipitation of the phosphoric acid, M. B. HARDIN (*South Carolina Sta. Bul. No. 8, n. ser., Dec., 1892, pp. 7–10*).—From comparative tests of a number of different methods of solution, the conclusion is reached that "the most satisfactory preliminary operations in the determination of the total, the water-soluble, or the citrate-insoluble phosphoric acid in cotton-seed meal, consist in treating the meal, the water-extract, or the citrate-insoluble residue by one of the following methods: (1) Sulphuric acid and potassium nitrate (Burney); (2) incineration, solution in hydrochloric acid, and replacement of hydrochloric by nitric acid."

Fertilizer inspection in Connecticut (*Connecticut State Sta. Report for 1892, pp. 50–119*).—This includes an abstract of the State fertilizer law and a list of dealers complying with it; popular explanations regarding the analysis and valuation of fertilizers; the market prices of the essential elements of plant food during 1892; a classification of the fertilizers analyzed, with comments on their source and quality; formulas, analyses, and valuations of home-mixed fertilizers; instructions for sampling wood ashes; a review of the fertilizer market for the year ending December 31, 1892; and tabulated analyses of 261 samples of fertilizing materials, including manipulated fertilizers, home mixtures, nitrate of soda, sulphate of ammonia, cotton-seed meal, castor-bean pomace, Odorless Phosphate, dissolved boneblack, dissolved bone, acid phosphate, sulphate of potash, potash and magnesia sulphate, muriate of potash, kainit, bone manures, tankage, dried fish, cotton-hull ashes, wood ashes, "Fossiliferous Phosphatic Marl," and phosphatic marl

(both from Virginia), oyster-shell lime, soap-factory refuse, silkworm refuse, horn waste, wool waste, tobacco dust, and muck.

Guaranties.—Of the forty-six brands [of nitrogenous superphosphates] here reported, eleven are below their minimum guaranty in respect of one ingredient and four in respect of two ingredients—that is, one third of all the nitrogenous superphosphates in our market contains less of one or of two ingredients than they are claimed to contain. * * *

Of the thirty-nine brands of special manures analyzed sixteen are below the manufacturers' minimum guaranty in respect of one ingredient and one is below in respect of two ingredients.

Cost and valuation.—The average cost of the nitrogenous superphosphates, excluding two analyses, in which cost exceeds valuation by considerably more than 50 per cent, is $35.28; the average valuation, $25.46; and the percentage difference, 27.8. * * *

The average cost per ton of the special manures has been $38.28, the average valuation $30.70, and the average percentage difference 25; a little higher than in case of the nitrogenous superphosphates.

Last year the corresponding figures were: Average cost, $38.84; average valuation, $31.64; percentage difference, 22.8.

Home-mixed fertilizers.—The mechanical condition of most of these mixtures was excellent, being as fine and as dry as average factory-mixed goods.

The average cost of the raw material used in the mixtures was $33.25 at regular market rates, disregarding discounts, which most of the purchasers received. If we add to this $1.50 for freight and $2 per ton for mixing, an allowance which is very ample, the total average cost will be $36.75 per ton. The average valuation is $33.16 per ton, and the percentage difference between cost and valuation $10.80.

The percentage differences between cost and valuation in case of the factory-mixed superphosphates and special manures this year is more than twice as large, indicating that there was in these cases great economy in home-mixing.

Commercial fertilizers, C. A. GOESSMANN (*Massachusetts State Sta., Bul. No. 46, Mar., 1893, pp. 8*).—A circular on the method of inspection in Massachusetts, trade values of fertilizing materials in raw materials and chemicals, instructions to fertilizer dealers, and tabulated analyses of wood ashes, logwood ashes, ashes from cremation of swill, double superphosphate, phosphate of ammonia, phosphate of potash, and ground bone.

Analyses of commercial fertilizers, L. L. VAN SLYKE (*New York State Sta., Bul. No. 52, Mar., 1893, pp. 149-191*).—Trade values of fertilizing materials for 1893, and tabulated analyses of 239 samples of commercial fertilizers collected during the spring and fall of 1892.

Fertilizers, G. C. WATSON (*New York Cornell Sta. Bul. No. 52, May, 1893, pp. 72-74*).—A popular discussion of the valuation and use of fertilizers.

FIELD CROPS.

A. C. TRUE, *Editor.*

Field experiments with corn, 1892, G. E. MORROW and F. D. GARDNER (*Illinois Sta. Bul. No. 25, Apr., 1893, pp. 173–204*).

Synopsis.—Accounts are given of experiments in the following lines: (1) Test of varieties; (2) time of planting; (3) depth of planting; (4) thickness of planting; (5) planting in hills or drills; (6) frequency and depth of cultivation; (7) root pruning; (8) cross-fertilization; (9) increase of dry matter with the growth of the plant, and (10) detasseling. The results of these and previous experiments at the station favor (1) large medium maturing varieties; (2) planting about May 1; (3) shallow planting; (4) relatively thick planting; (5) either hills or drills; (6) only enough cultivation to keep the soil free from weeds; (7) avoidance of root pruning; (8) cross-breeding to increase yield; (9) allowing corn to become mature before cutting; and (10) not detasseling. The experiments in 1892 were in continuation of those reported in Bulletin No. 20 of the station (E. S. R., vol. III, p. 847).

As in previous years, the experiments were conducted on dark-colored, fertile prairie soil about 18 inches deep, with a yellow clay subsoil. As a rule four kernels were planted in each hill. The hills were 3⅔ feet apart each way. The rainfall was excessive in May and June, but below the average later in the season. The average mean temperature during May to September was 67.4° F., which is below the normal.

Corn, test of varieties (pp. 176–191).—Seventy-eight varieties were tested in 1892. The results, as in the case of the similar experiments previously reported, are given in detail in tables, summaries, and general notes. Mixtures of two and four varieties in four cases out of five gave smaller yields than the single varieties. Cross-bred corn planted on five plats invariably gave larger yields than either of the parent varieties.

Corn, time of planting (pp. 191–194).—In 1892 Murdock and Burr White varieties were planted at intervals of a week from April 30 to June 20. The average height of the tallest stalks on each plat, measured each week from June 13 to September 21, is tabulated, together with the yield of corn and the per cent of water in the corn.

Corn, depth of planting (p. 194).—The results of planting corn at depths of from 1 to 7 inches during four years are tabulated. The yields decreased as the depth of planting increased.

Corn, thickness of planting (pp. 194–196).—Tabulated data are given for experiments in which from 1 to 4 kernels were planted in hills from 3 to 60 inches apart.

Corn, planting in hills or drills (p. 197).—Notes and tabulated data on an experiment in which corn was planted in hills on one half of each of 5 half-acre plats, and in drills on the other half.

Corn, frequency and depth of cultivation (pp. 197, 198).—Ordinary and frequent cultivation at different depths was compared with mere removal of the weeds on 10 plats.

Corn, root pruning (pp. 198, 199).—Alternate rows of corn were root pruned July 7, 15, and 28, as in former years. The results are tabulated.

Corn, cross-fertilization (pp. 199, 200).—In 1892 a small plat was planted with kernels from each of 50 ears of corn obtained by artificial cross-fertilization in 1890.

Corn, increase of dry matter with the growth of the plant (pp. 200, 201).—Brief notes on observations at the station during four years.

The chemical analyses, made under direction of Mr. Farrington, chemist of the station, show that, while there has been a fairly uniform increase in the weight of the ash, protein, fiber, nitrogen-free extract, and the fat or ether extract up to the date when the corn was fairly well matured, the composition of the dry matter shows a steady decrease in the percentage of ash and protein; at first there is an increase and then a decrease in the percentage of fiber; a steady increase in the percentage of nitrogen-free extract; and a good deal of variation in the percentage of ether extract with, in general, a considerable decrease until the plant becomes nearly mature.

Corn, detasseling (p. 201).—The tassels on ten alternate rows were removed as soon as they appeared.

Summary of experiments (pp. 173–176).

Seventy-eight samples of corn, with different names, were tested on contiguous plats, each one fortieth of an acre in extent. For the first time in five years, the late varieties gave the largest average yields, nine such varieties averaging 70 bushels. Sixty-seven plats of medium-maturing varieties averaged 68 bushels per acre, and 16 plats of early-maturing varieties averaged nearly 53 bushels. For five years past each of four medium-maturing varieties has given yields of from 71 to 76 bushels per acre.

The best early-maturing variety has given in the same time average yields of 65 bushels per acre. For three years past the best yield by any variety was 83 bushels per acre, by Boone County White. The largest yield in 1892 was almost exactly 100 bushels per acre of air-dry corn, of the variety known as Piasa Queen—a variety maturing too late for central Illinois. The trials for six years indicate that the larger medium-maturing varieties give the best results. Among these the Boone County White, Champion White Pearl, and Burr White represent the most satisfactory type of white, while the Leaming has given the best results among the yellow varieties. The Murdock has given the best yields of any early-maturing variety—65 bushels per acre for five years.

Excellent varieties were obtained from many different places. Extravagant claims, such as yields of 100 bushels per acre under ordinary cultivation, or that any variety worth cultivating matures in eighty or ninety days, when planted at the usual time, are not to be accepted as correct. In ordinary circumstances, one hundred days from date of planting may be considered as a minimum for field corn to mature fully; late varieties often need one hundred and fifty days in central Illinois.

Repeated trials have uniformly shown that larger yields of both corn and stalks are obtained by planting a larger number of kernels than is customary in the best practice of Illinois. From 12,000 to 13,000 kernels planted per acre seems to be the minimum for largest yields at the station grounds. This is equivalent to 4 kernels per hill, in rows at the usual distance for planting in Illinois. In most of the trials the rows were 3 feet 8 inches apart each way. Twenty-four varieties were planted in as many plats, half of each having 3 kernels and half 4 kernels in each hill. In 21 of the 24 cases the larger yields were obtained from the thicker planting, the average increase for the 24 plants being about 4.5 bushels per acre.

Repeated trials have shown that, if other conditions are the same, there is no perceptible difference in the average yield, whether the corn is planted in hills or in drills, the number of stalks secured influencing this rather than their mode of distribution. In many cases it is more difficult to keep drilled corn free from weeds. To secure the largest yield of both corn and stalks, medium-maturing varieties may be planted at the rate of 1 kernel to each 3 inches in rows 3 feet 8 inches apart. Thick planting gives smaller ears, which increase the labor in husking. Where the corn is to be fed without husking the smaller size of the ears may be an advantage.

As in each of several previous years, trials in 1892 show that shallow cultivation is better than deep, and that more frequent cultivation than is necessary to keep the soil free from weeds and the surface fairly loose is not profitable. On the station grounds weeds were the chief enemy to the corn plant. Fair yields of corn have been secured in each of several years without any cultivation after planting other than scraping the surface with a sharp hoe. Root pruning has uniformly decreased the yield.

In 1892 the largest yields were obtained from planting April 30, the soil being in better condition than at the later plantings. The average results for five years show no great variation in the yield of medium-maturing varieties planted at any time during May. The earlier plantings have required more cultivation than the later ones. Within reasonable limits, time of planting seems to have less influence on yield than the condition of soil at time of planting.

In each of five cases the yield from plats planted with cross-bred corn was larger than the average yield of the plats planted with the varieties which had not been crossed; the average increase was over 9 bushels per acre. In four out of five cases plats planted with mixtures of different varieties of corn gave a smaller yield than the average of the plats planted with the same varieties separately, the average decrease being 3.7 bushels per acre.

A medium-sized, medium-maturing variety, planted June 3, reached its maximum height August 19, seventy-seven days from planting. The dry matter continued to increase until the corn was fairly mature, September 16. It had but little more than half the total quantity of dry matter when the stalks had reached their greatest height, and not more than one third when tasseling began. In the week from July 22 to 29 there was a growth of 28 inches, or 4 inches per day.

No noticeable effect on yield was produced by removing tassels from alternate rows.

Trials at the station show that the corn grown last year on the university farms at Champaign has less vitality than corn kept under like conditions any year for the last ten. Early-maturing varieties show nearly perfect vitality, but not more than 80 to 85 per cent of the kernels of medium-maturing varieties germinated under conditions more favorable than ordinarily met with in field planting.

Observations on the growth of maize continuously on the same land (*Connecticut State Sta. Report for 1892, pp. 122–129*).—This was in continuation of work reported in the Annual Report of the station for 1891 (E. S. R., vol. III, p. 770). The same fertilizers were applied in 1892 as in previous years. The yields of kernels, cobs, and stover on the different plats are given, together with the food constituents. The quantities of nitrogen, phosphoric acid, and potash applied in the fertilizers and removed in the crop, the yields of shelled corn, and the percentage composition of dry matter during five years are also tabulated. Discussion of the results is reserved until more data are collected.

Enrichment or impoverishment of soil by five years' manuring and cropping of corn.

	Cow manure.			Hog manure.		
	Nitrogen.	Phos. acid.	Potash.	Nitrogen.	Phos. acid.	Potash.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
After four years' cropping	+302.1	+340.2	+330.5	+550.7	+1,219.9	+72.3
Applied in 1892	286.3	136.4	204.5	419.9	586.5	72.4
Taken off in crop of 1892	93.9	29.6	94.6	115.6	40.0	101.3
Excess (+) or deficiency (—) after five years' cropping	+494.5	+447.0	+440.4	+855.0	+1,766.4	+43.4

	Fertilizer chemicals.			No fertilizer.		
	Nitrogen.	Phos. acid.	Potash.	Nitrogen.	Phos. acid.	Potash.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
After four years' cropping	+106.2	+403.8	+92.2	—183.6	+97.1	—10.8
Applied in 1892	172 0	162.0	69.0	00.0	00.0	00.0
Taken off in crop of 1892	94.1	29.1	65.3	43.5	14.6	18.5
Excess (+) or deficiency (—) after five years' cropping	+184.1	+536.7	+95.9	—227.1	+82.5	—29.3

* The total amounts of fertilizing elements applied during 1888-1891 in excess of the quantities removed by the crops of those years.

Grasses, forage plants, and tomato blight, P. H. Rolfs (*Florida Sta. Bul. No. 18, pp. 10, fig. 1*).—Brief notes on forage plants and tomato blight. Among the grasses tried hairy-flowered paspalum (*Paspalum dilatatum*) proved most satisfactory.

Experiments in growing tobacco with different fertilizers, S. W. Johnson (*Connecticut State Sta. Report for 1892, pp. 1–28*).

Synopsis.—The following subjects are treated in the report: Analyses of fertilizers used, the culture and curing of the crop, weights and percentages of the different grades of leaf, number of leaves to the pound, burning quality, description of an apparatus for burning cigars evenly, and relation of chlorine in the fertilizer to the same element in tobacco. Cotton-seed meal, castor pomace, nitrate of soda, cotton-hull ashes, double-manure salt, high-grade sulphate of potash, carbonate of potash, lime, and several brands of manipulated fertilizers in various combinations were tested on tobacco. The castor pomace plats averaged 75 pounds of unfermented leaves in excess of the cotton-seed meal plats. In a crop of 1,875 pounds of pole-cured leaves and 3,200 pounds of pole-cured stalks there are removed from the soil about 100 pounds of nitrogen, 100 pounds of lime, 140 pounds of potash, and only 16 pounds of phosphoric acid.

For the purpose of carrying on experiments in the culture and cure of tobacco, a number of tobacco planters organized under the name of The Connecticut Tobacco Experiment Company. The company provided land in Poquonock, in the town of Windsor, Connecticut, and intrusted the supervision of the experiments and publication of results to the station.

By the plan adopted the experiment with fertilizers is to be carried out on the same land for at least five consecutive years; special attention is to be given to the quality of the tobacco for cigar wrappers, judging of quality after the leaves have been fermented in the usual way.

The following questions are the first to receive attention: What is the effect on quantity and quality of leaf of large applications of cot-

ton-seed meal, or of castor pomace containing the same quantity of nitrogen? What is the effect of a heavy ration of nitrogen, half from castor pomace and half from nitrate of soda? What are the comparative effects on quantity and quality of the leaf from the use of equal quantities of potash in the following forms: Cotton hull ashes, high-grade sulphate of potash, the same with lime, double sulphate of potash and magnesia, the same with lime, pure carbonate of potash, and pure nitrate of potash? Can pole-burn be prevented by the use of artificial heat simply as a means of ventilating and partly drying the air?

The soil of this field is like much of the upland tobacco soil of the Connecticut Valley, and may be described as a very fine light sandy loam. * * *

For five or six years the field had scarcely been fertilized or cultivated at all and tobacco had not been raised there for a very long term of years. When bought it was covered with a neglected growth of poverty grass (*Andropogon scoparius*), blackberry vines, and wild growth of various sorts.

The variety grown was the Hubbard, which belongs to the Havana type. All fertilizers were analyzed by the station.

The following table gives the amounts of nitrogen, phosphoric acid, and potash, as well as the quantity of fertilizer per acre.

Analysis, cost, and amount of fertilizers.

Name of plat.	Fertilizers.	Quantity per acre.	Cost per acre.	Fertilizer contains— Nitrogen.	Phosphoric acid.	Potash.
		Pounds.		*Lbs.*	*Lbs.*	*Lbs.*
A	Cotton-seed meal	1,500	$50.20	105	150	341
	Cotton-hull ashes	1,500				
B	Cotton-seed meal	2,000	57.25	140	105	350
	Cotton-hull ashes	1,500				
C	Cotton-seed meal	2,500	63.75	175	180	359
	Cotton-hull ashes	1,500				
D	Cotton-seed meal	3,000	70.50	210	195	368
	Cotton-hull ashes	1,500				
E	Castor pomace	1,980	50.79	105	139	334
	Cotton-hull ashes	1,500				
F	Castor pomace	2,640	57.72	140	150	340
	Cotton-hull ashes	1,500				
G	Castor pomace	3,300	64.65	175	161	347
	Cotton-hull ashes	1,500				
H	Castor pomace	4,000	72.00	212	173	354
	Cotton-hull ashes	1,500				
I	Castor pomace	2,640	68.72	210	150	340
	Cotton hull ashes	1,500				
	Nitrate of soda*	220				
	......do†	220				
J	Castor pomace	2,640	68.72	210	150	340
	Cotton-hull ashes	1,500				
	Nitrate of soda†	440				
K	Cotton-seed meal	1,500	43.95	110	150	311
	Double-manure salt	1,220				
	Cooper's bone	360				
L	Cotton-seed meal	1,500	44.70	110	150	311
	Double-manure salt	1,220				
	Cooper's bone and lime	360				
M	Cotton-seed meal	1,500	42.70	110	150	341
	High-grade sulphate of potash	620				
	Cooper's bone	360				
N	Cotton-seed meal	1,500	43.45	110	150	341
	High-grade sulphate of potash	620				
	Cooper's bone and lime	360				
O	Cotton-seed meal	1,500	‡74.95	110	150	341
	Carbonate of potash	580				
	Cooper's bone	360				

*Applied between rows at time of first cultivation.
†Applied between rows at time of second cultivation.
‡If brought in ton lots not chemically pure the cost would be considerably less.

Analysis, cost, and amount of fertilizers—Continued.

Name of plat.	Fertilizers.	Quantity per acre.	Cost per acre.	Fertilizer contains— Nitrogen.	Phosphoric acid.	Potash.
		Pounds.		*Lbs.*	*Lbs.*	*Lbs.*
P	Nitrate of potash	760	*$66.47	110	146	341
	Cooper's bone	500				
Q	Baker's A. A. superphosphate	2,020	....	230	466	510
	Baker's tobacco manure	3,920				
R	Stockbridge tobacco manure	2,000	....	99	207	126
S	Bowker's tobacco fertilizer	4,000	....	219	278	391
T	Ellsworth's "Starter"	900	....	215	238	168
	Ellsworth's "Foundation"	2,700				
U	Lime	501				
	Mapes's Starter	501	....	173	230	312
	Mapes's tobacco manure W B	2,601				
V	Lime	501				
	Mapes's Starter	501	....	170	205	418
	Mapes's tobacco manure special	2,601				
W	Lime	501				
	Mapes's Starter	501	....	176	227	364
	Mapes's tobacco manure special	2,601				
X	Sanderson's Formula B	6,080	....	345	581	643

* If brought in ton lots not chemically pure the cost would be considerably less.

The report cautions its readers not to make a final judgment based on the quantity and quality of the unfermented leaves; the weight and quality of the fermented tobacco are not presented in this publication. Of the 23 plats, 7 yielded crops of 2,000 pounds of unfermente leaves.

On the average the castor-pomace plats produced a very little more than the corresponding cotton-seed meal plats—1,866 pounds against 1,771 pounds—the average difference amounting to 95 pounds per acre. The difference in yield of wrappers was, however, only 17 pounds per acre in favor of the castor pomace. The difference in color was slight. That raised on cotton-seed meal inclined to be lighter than that from pomace. The lightest colors of all were in tobacco from the plats fertilized with cotton-hull ashes and either cotton-seed meal or castor pomace. The single exception is plat P, raised on nitrate of potash and Cooper's bone, which was the lightest in the experiment; but the yield from this plat was very small and the burn was poor.

With the same quantities of nitrogen and phosphoric acid a like quantity of potash in the form of double sulphate of potash and magnesia gave a larger total crop and a larger weight of wrappers than either cotton-hull ashes, high-grade sulphate of potash, or carbonate of potash. There was no very great difference in the color of the crops raised on these different forms of potash. * * *

It appears that a large yield is generally accompanied with a large pecentage of wrappers. Of the ten crops which had more than 70 per cent of wrappers in them, six produced more than 2,000 pounds to the acre and all of them over 1,800 pounds. * * *

The tobacco from the following plats glowed longer than that from any other:

Plat F, castor pomace and cotton-hull ashes; P, nitrate of potash and bone; C, cotton-seed meal and ashes; G, castor pomace and ashes; J, castor pomace and ashes with nitrate; O, cotton-seed meal, carbonate of potash, and bone; D, cotton-seed meal and ashes.

The tobacco from the following plats glowed for a shorter time than any other:

Plat W, Mapes; Q, Baker; X, Sanderson; T, Ellsworth; U, Mapes; M, cotton-seed meal, high-grade sulphate, and bone; V, Mapes.

In the judgment of experts, based on the appearance of the unfermented leaves, the best kinds of tobacco were produced on plats A, I, G, F, N, K, and O. Plat V had the poorest burn of any.

The formulas used supply from 99 to 345 pounds of nitrogen, 150 to 581 pounds of phosphoric acid, and 168 to 643 pounds of potash.

The amount of fertilizing material withdrawn from the soil per acre by a crop of 8,000 tobacco plants, yielding 1,875 pounds of pole-cured leaves and 3,200 pounds of pole cured stalks, is given in the following table:

Elements removed from the soil in 1,875 pounds of pole-cured leaves and 3,200 pounds of pole-cured stalks.

	In the leaves.	In the stalks.	Total.
	Pounds.	*Pounds.*	*Pounds.*
Nitrogen	65	32	97
Phosphoric acid	8	8	16
Potash	89	49	138
Soda	4	3	7
Lime	81	13	94
Magnesia	25	5	30
Sulphuric acid	16	5	21
Chlorine	5	6	11

An apparatus used in testing the burning quality of tobacco is described. A cigar placed in this is smoked at a uniform rate and a perfect cone of ash results.

Chemical changes in tobacco during fermentation, S. W. JOHNSON (*Connecticut State Sta. Report for 1892, pp. 28–31.*)

Synopsis.—During fermentation three grades of tobacco lost different percentages of their total weights, and the losses fell unequally on the different constituents.

From a pole-cured crop of tobacco duplicate lots were selected in December, 1891, of upper leaves; "short seconds," or lower leaves on the stalks; and "first wrappers," the best leaves on the stalks. The upper leaves were of course not fully ripe when cut, the lower leaves were a little overripe, and the "first wrappers" were cut at the proper time.

One of the duplicates of each class was analyzed, the other cased down and fermented. The following table gives the analyses of fermented and unfermented leaves:

Analyses of fermented and unfermented leaves.

	A Upper leaves.		B Short seconds.		C First wrappers.	
	Unfermented.	Fermented.	Unfermented.	Fermented.	Unfermented.	Fermented.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Water	23.50	23.40	27.40	21.10	27.50	24.90
Ash *	14.89	15.27	22.85	25.25	15.84	16.22
Nicotine	2.50	1.79	0.77	0.50	1.26	1.14
Nitric acid (N_2O_5)	1.89	1.97	2.39	2.82	2.59	2.35
Ammonia (NH_3)	0.67	0.71	0.16	0.16	0.33	0.47
Other nitrogenous matters †	12.19	13.31	6.69	6.81	11.31	11.62
Fiber	7.90	8.78	7.89	8.95	9.92	10.42
Starch	3.20	3.36	2.62	3.01	2.89	3.08
Other nitrogen-free extract	29.39	27.99	26.28	28.36	25.52	26.88
Ether extract	3.87	3.42	2.95	3.04	2.84	2.92
	100.00	100.00	100.00	100.00	100.00	100.00

* Free from carbonic acid and carbon.

† Nitrogen other than that of nicotine, nitric acid and ammonia, multiplied by 6¼.

The upper leaves, short seconds, and first wrappers lost by fermentation 9.7, 12.3, and 9.1 per cent, respectively, of their total weight.

But while three fourths of the loss in the case of the short seconds consisted of water, in the case of the upper leaves almost three fourths of the loss was of dry matter. The first wrappers lost a little less dry matter than water. * * *

The upper leaves lost more than a third of their nicotine, the short seconds somewhat less than half, and the first wrappers less than one sixth of it.

The upper leaves, in which fermentation was evidently the most active, lost more than one seventh of their nitrogen-free extract and one fifth of their ether extract. * * *

The fermentation of first wrappers destroyed only 5.8 per cent of their dry matter. They lost but a little nicotine, and, aside from the ash, the chief losses were of nitrogenous matters other than nicotine and of nitrogen-free extract which includes the "gum" of tobacco.

Analyses of tobacco stalks when cut and after curing, S. W. JOHNSON (*Connecticut State Sta. Report for 1892, pp. 31–34*).—August 22 three lots, A, C, and D, of four tobacco plants each were selected. The lots were as nearly uniform as possible.

In lot A the lower leaves were ripe, but the whole plants were not ready to cut for curing on the stalks. It was cut August 22, the leaves stripped off, and the stalk analyzed.

On September 7 lot D was cut, stripped, and the stalks analyzed. The plants were fully ripe.

On the same date lot C was cut and put into a curing barn with the leaves on the stalks. On October 16 the leaves were stripped off and the cured stalks analyzed.

From the results of these analyses the following table was calculated; it shows how many pounds of the several ingredients were contained in the stalks from an acre of tobacco, 8,000 plants:

Ingredients in 8,000 tobacco stalks.

	A. Cut Aug. 22, unripe.	D. Cut Sept. 7, ripe.	C. Cut Sept. 7, and cured till Oct. 16.
	Pounds.	*Pounds.*	*Pounds.*
Total weight per acre	9,437.0	9,750.0	3,438.0
Water	8,159.0	8,422.0	2,115.0
Dry matter	1,279.0	1,328.0	1,323.0
Starch	147.0	189.0	171.0
Dextrose	38.0	36.0	8.7
Nicotine	6.6	8.8	?
Total nitrogen	25.5	32.2	41.8
Total phosphoric acid	5.5	5.8	7.9
Total potash	47.8	50.6	54.7
Soda	1.1	1.1	0.9
Lime	11.9	15.4	14.7
Magnesia	5.6	6.8	6.9
Oxide of iron and alumina	1.2	1.3	0.7
Sulphuric acid	6.8	6.3	7.4
Chlorine	5.6	6.5	6.8

These figures show a slight gain by the stalk in almost every ingredient in the period of growth between August 22 and September 7.

Double carbonate of potash and magnesia for tobacco, S. W. JOHNSON (*Connecticut State Sta. Report for 1892, pp. 31, 35*).—The following table gives the analysis of this Stassfurt salt, which has recently been recommended as a fertilizer for tobacco:

Potash	18.10
Soda	1.49
Lime	1.20
Magnesia	19.27
Oxide of iron and alumina	2.31
Chlorine	0.15
Carbonic acid	32.55
Water, mostly combined	25.12
	100.22

Tobacco, J. P. DE PASS (*Florida Sta. Bul. No. 19, 1892, pp. 13*).—General directions for the culture of tobacco. All experiments with tobacco in 1892 were destroyed by wind, rain, and hail. Analyses of soil from a field on the station farm where tobacco was grown and from a tobacco field in Cuba are given. The Cuban soil contained a high percentage of organic matter, lime, and oxide of iron. There is also an analysis of a stalk of tobacco grown in Cuba.

Experiments in wheat culture, F. E. EMERY (*North Carolina Sta. Bul. No. 91, Apr. 29, 1893, pp. 19*).

Synopsis.—A record of the yields of the third and fourth years from plats on which wheat has been grown continuously. Kainit, superphosphate, and cotton-seed meal alone and in combination were applied yearly to land on which a crop of cowpeas was grown every summer, and to land on which no pea vines were grown. The cowpeas increased the yield of grain in 1891 by an average of 13.78 bushels per acre and in 1892 by 15.6 bushels. The use of cowpeas as a manure resulted in nearly doubling the number of stalks per stool, increasing the height of plants by nearly 9 inches, and the length of heads by ⅝ of an inch. The average results of the four years' experiment are given, and also notes on an obscure wheat disease, tests of varieties, and seeding at different depths.

The continuation of an experiment commenced in 1888, reported in Bulletins Nos. 72 and 77 of the station (E. S. R., vol. II, p. 372; III, p. 172), and having in view the determination of the value of pea-vine manuring for wheat.

In 1888 seven twenty-fifth-acre plats were laid out, half of each plat being on land in which a crop of cowpeas had been plowed under. On the same half of each plat cowpeas were grown during each succeeding summer and plowed under before seeding to wheat in the fall. The other half of each plat was undisturbed between the harvesting of one wheat crop and the fall preparation for the next.

The following table shows the fertilizers applied to each plat and the yield per acre in 1891 and 1892 with and without pea vines, and the gain or loss due to fertilizers:

Gains due to commercial fertilizers and cowpea vines.

No. of plat.	Fertilizers per acre.	Cost per acre.	Grain per acre.		Gain due to fertilizers.*	
			With pea vines.	Without pea vines.	With pea vines.	Without pea vines.
	1891.					
			Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
1	No fertilizer	$0.00	†11.72	8.41		
2	Kainit 300 pounds	2.55	‡14.22	7.29		0.98
3	Superphosphate 300 pounds	2.70	27.66	7.60	8.90	1.29
4	Superphosphate 175 pounds, cotton-seed meal 87.5 pounds, kainit 37.5 pounds	2.94	27.03	8.36	8.27	2.05
5	No fertilizer	0.00	19.95	4.22		
6	Cotton seed meal 300 pounds	3.60	24.48	11.09	5.72	4.78
7	Superphosphate 350 pounds, cotton-seed meal 17.5 pounds, kainit 75 pounds	5.88	28.23	9.84	9.47	3.53
	Average actual yield		21.90	8.12		
	1892.					
§1	No fertilizer	0.00	8.75	7.50		
§2	Kainit 300 pounds	2.25	8.81	5.42		
3	Superphosphate 300 pounds	2.55	26.41	7.31	7.76	1.45
4	Superphosphate 175 pounds cotton-seed meal 87.5 pounds, kainit 37.5 pounds	2.82	27.24	9.17	8.51	2.01
5	No fertilizer	0.00	18.65	6.82		
6	Cotton seed meal 300 pounds	3.60	24.90	11.93	6.25	4.77
7	Superphosphate 350 pounds, cotton-seed meal 175 pounds, kainit 75 pounds	5.64	24.17	11.67	5.52	4.51
	Average actual yield		24.25	8.55		

* The average of the yields of the two unmanured plats has been taken as the basis on which to calculate the "gain due to fertilizers."
† In making up the columns of "gain due to fertilizers," the mean yields of the unfertilized plats with pea vines has been increased one half on account of disease on plat 1.
‡ No correction for diseased area, though the crop was only about two-thirds of a normal yield.
§ Not used in making averages and comparisons on account of disease.

In 1891 the pea vines increased the crop by 1,796 pounds of straw and 13.78 bushels of wheat per acre. Phosphoric acid when applied in connection with pea vines caused the largest net gain over the unfertilized plats and the heaviest financial loss when applied without pea vines. In 1892 phosphoric acid with pea vines gave the second largest net gain and the second largest loss when applied without pea vines.

The effect of fertilizers and of pea vines in 1892 on the tillering, height, and length of head of the plants, is seen in the following table:

Effect of green manuring with cowpeas on the growth of wheat.

Number of plat.	Plats without cowpea vines			Plats with cowpea vines.		
	Average number of stalks per stool.	Average height of stalks.	Average length of panicles.	Average number of stalks per stool.	Average height of stalks.	Average length of panicles.
		Inches.	*Inches.*		*Inches.*	*Inches.*
1	1.80	22.0	1.92	*2.80	*29.4	*2.55
2	1.92	20.0	2.07	*2.24	*26.8	*2.46
3	2.04	20.0	1.96	4.36	34.4	2.45
4	1.68	24.0	2.02	3.44	35.3	2.58
5	1.76	20.0	1.88	3.00	31.9	2.70
6	1.80	28.0	2.11	3.24	35.6	2.99
7	1.56	28.0	2.11	3.04	36.7	2.75
Averages	1.78	23.1	2.01	3.16	32.9	2.64

*All measurements taken on unaffected or least affected corners.

The wheat was separated into three grades. In 1891 there was in the lowest grade 5.17 per cent of the crop grown after pea vines, and 10.42 per cent of the crop grown without pea vines. In 1892 the lowest grade contained 1.98 per cent of the crop grown after pea vines and the same proportion of the crop without pea vines.

Taking the average of four years, the gain per acre in the yield of wheat from pea-vine manuring is as follows: With no fertilizers, 9.68 bushels; with 300 pounds kainit, 16.46; with 300 pounds acid phosphate, 16.81; with 175 pounds acid phosphate, 87.5 pounds cotton-seed meal, and 37.5 pounds kainit, 14.67; with 300 pounds cotton-seed meal, 7.83.

The half of plats 1 and 2, on which pea vines had grown, suffered from an obscure disease. A fungus was found in the roots of the wheat plant, but could not be identified.

Tabulated data for 17 varieties of wheat and for wheat sown at different depths are given.

Wheat growing and dairying in North Dakota, E. F. LADD and W. H. WHALEN (*North Dakota Sta. Bul. No. 8, Dec., 1892, pp. 14*).—Analyses of four grades of wheat found in North Dakota gave the following average results:

Analyses of different grades of wheat.

Grade.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.
No. 1, hard	1.79	17.21	2.38	76.25	2.37
No. 1, northern	2.20	17.93	3.41	74.01	2.45
No. 2, northern	2.24	18.33	3.23	73.91	2.29
No. 3, northern	2.35	20.66	3.24	71.32	2.43

The bulletin contains a statement of the amount of wheat shipped from North Dakota, and of the amount of flour, screenings, bran, and middlings made from this crop. The fertilizing ingredients contained in the bran and middlings are calculated, and dairying is pointed out as a means of utilizing the by-products of wheat and thus retaining in the State these valuable fertilizing elements.

Conditions affecting the value of wheat for seed, H. L. BOLLEY (*North Dakota Sta. Bul. No. 9, Mar., 1893, pp. 1–26, figs. 9*).—The author, in a somewhat popular manner, discusses the principles underlying the germination of plants and what qualities in seed may be expected in the progeny. The influence of water and extremes of temperature upon seed and plants is stated. The microscopic structure and the process of the germination of the wheat grain are discussed at some length.

Tests of quite a number of samples of suspected seed were made, giving from 8 to 96 per cent of germinations. In nearly every case field germinations were attempted. The per cent sprouted in the field was always much lower than in the germinating apparatus, and the condition of the plants produced was proportional to the germination.

Frosted, immature, heated, and winter-bleached wheats were examined and their characteristics noted. Germination tests showed them of varying value as seed. Whenever such seed must be used a larger amount should be sown than if the best quality were used.

At the suggestion of the director of the station a simple germinating apparatus was used with good results. It consists of two shallow pans of different diameters; the larger contains about an inch of water. In this is inverted the smaller pan, over the bottom of which is placed a folded cloth with the ends dipping into the water. The cloth is uniformly moistened and the seed placed between the folds. Germinations of good seed are usually completed in four or five days at a temperature of 55°–80° F. For poor seed a longer period is required.

The author's conclusions are as follows:

The qualifications of different samples of wheat for seed purposes vary with each sample; each should be studied as to its own merits.

When in doubt, the dryest, heaviest, hardest, best market grades of wheat are the ones to rely upon for seed purposes.

Immature wheats, no matter what the cause, whether drouth, attack of rust, or premature harvest, are weakened in seed value, because of lack of full food supply in the grain, and perhaps immaturity of the germ.

Mixed varieties of seed should not be sown because there will be inequality in ripening.

The best grades of frosted seed possess less strength in their first growth from the grain than is the case with best grades of mature wheat.

Wheat that has been wet and subject to freezing and thawing during the winter can not safely be used as seed without being tested.

Any seeds which have at any time been heated because of moisture, when in bulk, are very liable to have been injured beyond ability to grow.

If stacks are made from well cured, mature wheat, and remain dry throughout the winter, the wheat threshed from such in the spring will be as good seed as if otherwise stored.

Wheat threshed from the shocks in the spring of 1892 after winter bleaching was generally dead.

Experiments with oats and wheat, J. F. DUGGAR (*South Carolina Sta. Bul. No. 7, Sept., 1892, pp. 16.*—Cotton seed and cotton-seed meal were compared as fertilizers for oats and wheat, using 2 pounds of seed as equivalent in cost to 1 pound of meal. On land very deficient in organic matter cotton seed gave a larger increase in both crops.

Superphosphate in amounts of 360, 240, and 120 pounds per acre was applied alone and in combination with 240, 160, and 80 pounds of nitrate of soda on oats, and the test repeated on two fields of eight plats each. Acid phosphate gave but slight increase. Nitrate of soda alone and in combination largely increased the yield.

The effect of harrowing wheat in April was tested on twelve plats. In five experiments out of six the plats not harrowed yielded slightly more than the harrowed plats.

In a test of fertilizers on wheat, 80 pounds of nitrate of soda and 160 pounds of cotton-seed meal gave practically the same yield.

Tabulated data and notes on 6 varieties of oats and 12 varieties of wheat are also given.

HORTICULTURE.

A. C. TRUE, *Editor.*

Four new types of fruits, L. H. BAILEY (*New York Cornell Sta. Bul. No. 51, Apr., 1893, pp. 33–45, plates 2, figs. 4*).—Illustrated accounts of the Simon or apricot plum (*Prunus simonii*), wineberry (*Rubus phœnicolasius*), Crandall currant (*Ribes aureum*), and dwarf juneberry (*Amelanchier canadensis*, var. *oblongifolia*).

Simon or apricot plum (pp. 34–37).—This fruit was introduced into France from China in 1872, and from France into this country, where it began to fruit about 1885.

The fruit is flattened longitudinally, marked with a deep stem cavity and a very prominent suture, and is borne upon a very short stem. The color is very intense and striking, being a glowing dark red slightly mottled with lighter shades The flesh is yellow, hard, and clings tightly to the somewhat apricot-like pit. The flavor in all the specimens which I have tasted is very disagreeable, being mawkish, bitter, and leaving a pronounced bitter almond taste in the mouth. I have never tried a specimen which I could say was edible, and this is an unwilling confession because the fruit is exceedingly attractive to look upon. * * *

It is not a productive tree so far as I have observed, and I have seen it in many different plantations. It bears young, but the fruiting is not profuse. * * *

The two transcendent merits of the fruit of *Prunus simonii* are the very handsome shape and color, and its long keeping qualities consequent upon its hard flesh. Ripe fruits will ordinarily keep a week or ten days in good condition. And aside from these merits, the tree appears to be as hardy as the common plums. But it blooms early and is often caught by late frosts. * * *

Prunus simonii is a wholly distinct species from any other stone fruit. It is not a hybrid between the plum and apricot, as some have supposed. * * *

It grows well upon plum stocks, upon which it is probably oftenest worked in the North. It also takes upon the peach, and upon the Myrobalan and Marianna plums.

After some years of study of this fruit I am forced to conclude that it is worthless for orchard cultivation in New York. It is possible that hybrids between this and the peach or other fruits may possess commercial merit. If hybrids could be obtained with the peach, they might be expected to be hardier than the peach. As an ornamental tree, *Prunus simonii* has distinct merit, its erect poplar-like habit, interesting conduplicate leaves, early flowers, and glowing fruits making it a conspicuous object.

Wineberry (pp. 37–40).—This fruit was introduced into this country from Japan in 1887.

[As grown at the station] the fruits were very small—as raspberries go—and the pips were so little connected that the fruit crumbled when picked. The fruit was cherry red, acrid, and with little pronounced flavor. It had little either in size, appearance, or quality to recommend it. * * *

If our wineberry gives little promise for fruit, the plants nevertheless possess decided merit for certain kinds of ornamental planting. The bristly red canes and rich leaves with felt-white color beneath render the plant very striking; and the bright little fruits remind one of fragile coral beads sprinkled over the plant.

These fruits are at first inclosed in the burr-like calyx, and this covering is thought to afford the plants a distinct value in keeping insects from the fruit. "The hairy, viscous calyx, which covers the berry till it is full grown, effectually repels all insects," Prof. Georgeson writes. This may be true; but if the fruit were to develop

to the point of commercial usefulness, burrowing insects would undoubtedly find this dense calyx to be an excellent protection from outside attacks. The plant is about as hardy as the common raspberries here, although it failed to endure the winters at Kew, England (near London).*

Crandall currant (pp. 40–43).—"The Crandall currant was named for R. W. Crandall, of Newton, Kansas, who found it growing wild. It was introduced in the spring of 1888." Data are given to show that the fruits are very variable. The author thinks this type of currant may be the parent of a new and valuable race of small fruits.

At its best the Crandall has decided merits. The fruits are large and handsome, firm, of good culinary quality, and the plant is thrifty, hardy, and productive. The fruits are borne in very short and open clusters, to be sure, but they are not picked by the cluster like the red and white currants, but singly like the gooseberries. To some people the flavor of the fruit is disagreeable, and it has been called a medicinal flavor; but there are others—the writer included—who are fond of them, even to eat from the hand. In pies and jellies we have found them to be useful.

Dwarf juneberry (pp. 43–45).—The variety known as Success was brought to notice in Kansas in 1873 by H. E. Van Deman. "The fruit ripens here with the early currants and lasts nearly as long as the currants. Last year the fruits were picked July 18. The berries closely resemble huckleberries, as well in flavor as in appearance. They are, however, more juicy and palatable than huckleberries."

The favorable opinion of this fruit expressed by W. B. Alwood in Bulletin No. 22 of the Virginia Station (E. S. R., vol. IV, p. 728) is accepted by the author. Robins are very fond of this fruit.

Strawberries, L. F. KINNEY (*Rhode Island Sta. Bul. No. 22, pp. 43–58; plate 1, figs. 7*).—A popular account of the methods of culture of strawberries and tabulated data for 45 varieties tested at the station. The following varieties are especially commended: Lovett Early, Lady Rusk, Number 24, Bubach, Chas. Downing, Miner, Haverland, and Gandy.

Notes on small fruits, L. R. TAFT, H. P. GLADDEN, and R. J. CORYELL (*Michigan Sta. Bul. No. 92, Mar., 1893, pp. 20*).—Notes and tabulated data for 82 varieties of strawberries, 22 of black and 18 of red raspberries, 19 of currants, and 14 of gooseberries, grown at the station in 1892. There are also general notes on insects and fungous diseases affecting small fruits, and suggestions regarding spraying. The varieties especially commended are as follows: *Strawberries*—for home planting, Alpha, Cumberland, Sharpless, Parker Earle, and Gandy; for market use, Crescent, Pearl, Haverland, Bubach, Parker Earle, and Warfield. *Raspberries*—black, Souhegan, Tyler, Hopkins, Kellogg, Mammoth Cluster, Ohio, Shaffer (for canning), Gregg, and Nemaha; red, Michigan Early, Cuthbert, and Turner. *Currants*—Red Dutch, Victoria, White Dutch, and White Grape. *Gooseberries*—Industry and Downing. The Japanese wineberry is valuable "only as a curiosity."

Report on fruits, S. T. MAYNARD (*Massachusetts Hatch Sta. Bul. No. 21, Apr., 1893, pp. 23*).—Tabulated data for 96 varieties of strawberries, 12 of red and 15 of black raspberries, 13 of blackberries, and

* W. Watson, in Garden and Forest, vol. V, (1892) p. 66.

115 of grapes. The following are especially commended: *Strawberries*—Beder Wood, Belmont, Bubach No. 5, Edgar Queen, Haverland, Martha, Parker Earle, Parmenter Seedling, Seedling No. 24, and Woolverton. *Red raspberries*—Marlboro, Hansel, and Cuthbert. *Blackberries*—Agawam and Taylor. *Grapes*—Berckman, Brighton, Concord, Delaware, Iona, Lindley, Moore Early, Winchell, and Worden. Notes on spraying experiments on orchard and small fruits are also given. Bordeaux mixture was found to be effective in preventing rust on the black or Italian poplar.

Further examination of California prunes, apricots, plums, and nectarines, G. E. COLBY (*California Sta. Bul. No. 101, May 1, 1893, pp. 8*).—This is a continuation of work reported in Bulletins Nos. 93 and 97 of the station (E. S. R., vol. III, p. 78; IV, p. 157). The varieties for which notes and tabulated analytical data are given are as follows: *Prunes*—twelve unnamed French varieties, one unnamed German variety, Prune d'Agen, Wangenheim, Robe de Sergent, Fellenberg, Hungarian, Bulgarian, Datte d'Hongrie, and St. Catherine. *Plums*—Coe Golden Drop and Yellow Egg. *Apricots*—Royal, Hemskirk, Blenheim, Peach, and Moorpark. *Nectarines*—New White.

The following tables give the average results obtained during 1891 and 1892:

Average analyses of prunes, plums, apricots, and nectarines.

	Prunes.		Plums.	Apricots.	Nectarines, New White.
	French varieties.	All varieties.			
PHYSICAL ANALYSIS.					
Average weight ....grams.	26.300	25.600	60.400	62.400	102.500
Number ....per pound.	20.400	20.200	8.200	7.500	4.400
Flesh ....per cent..	94.200	94.200	95.200	93.850	93.400
Pits ....do....	5.800	5.800	4.800	6.150	6.600
FLESH.					
Juice, pressed ....per cent..	83.100	78.800	75.300	90.000	89.300
Pulp, pressed ....do....	16.900	21.200	24.700	10.000	10.700
JUICE.					
Total sugar by copper (inversion) ....per cent..	23.690	20.000	17.970	13.310	17.170
Acid, in terms of sulphuric (SO_3) ....do....	0.310	0.400	0.480	0.680	0.620
SUGAR.					
In fresh flesh ....per cent..	19.700	16.110	13.250	11.930	15.130
In fresh fruit ....do...	18.530	15.350	12.800	11.100	14.110
NITROGEN.					
In whole fresh fruit ....per cent..	0.182	0.162	0.181	0.194	0.117
In fresh flesh ....do....	0.151	0.134	0.159	0.168	0.100
In fresh pits ....do....	0.710	0.635	0.559	0.751	0.260
Albuminoids in whole fresh fruit (equivalent to nitrogen) ....per cent..	1.137	1.012	1.133	1.250	0.731
ASH (PURE).					
In whole fresh fruit ....per cent..	0.578	0.436	0.535	0.491	0.498
In fresh flesh ....do....	0.565	0.474	0.524	0.477	0.490
In fresh pits ....do....	0.640	0.590	0.620	0.668	0.400
GENERAL PROXIMATE ANALYSIS.					
Water ....per cent..	72.820	77.380	77.430	85.160	79.000
Organic matter ....do....	26.602	22.134	22.035	14.349	20.502
Ash ....do....	0.578	0.486	0.535	0.491	0.498
Total	100.000	100.000	100.000	100.000	100.000

Ash analyses of prunes and apricots.

	French prunes.	Royal apricots.
	Whole fruit.	Whole fruit.
	Per cent.	*Per cent.*
Pure ash	0.486	0.508
Composition of pure ash:		
Potash	63.83	59.36
Soda	2.65	10.26
Lime	4.66	3.17
Magnesia	5.47	3.68
Peroxide of iron	2.72	1.68
Oxide of manganese	0.39	0.37
Phosphoric acid	14.08	13.09
Sulphuric acid	2.68	2.63
Silica	3.07	5.23
Chlorine	0.34	0.45
Total	99.89	99.92
Less excess of oxygen due to chlorine	0.08	0.11
Total	99.81	99.81

Proportion of pits to flesh, prunes.—The later work verifies our previous conclusion that these fruits contain about seventeen times as much flesh as pits.

Proportion of pits to flesh, plums.—In these the range in the percentages of pits is somewhat less than that for prunes. * * *

Proportion of pits to flesh, apricots.—For the fully ripe and largely grown varieties from all localities the variation of pit percentages is from 5.3 to 7.1, a smaller difference than is found in the prunes or plums. * * *

Proportion of juice to flesh, prunes and plums.—The French prune on the average shows the largest proportion of free juice, 4.3 per cent more than the average for all the prunes, namely, 83 per cent, or about four fifths of the flesh. * * * Three fourths of the flesh of the plum, on the average, is juice, thus showing the prune flesh one twentieth more juicy than that of the plum.

Proportion of juice to flesh, apricots.—The proportion of juice to flesh is nearly the same for all the samples, 90 per cent or nine tenths of the flesh being juice. * * *

Sugar content of the juice, flesh, and fruit, prunes and plums.—The ripe, juicy, soft-fleshed French prunes from all localities yield the highest sugar percentages, averaging in the juice, 23.69 per cent; the hard-fleshed ripe prunes yield an average of 15.24 per cent sugar—6.24 per cent less, while the average sugar for all prunes is 20 per cent, or 3.5 per cent less than that of the French prunes. * * *

The plums, among themselves, show in the juice a narrow range in sugar and average about 18.0 per cent of that substance—some 5.5 per cent less than the French prunes, and about 3.5 more than the hard-fleshed varieties.

Sugar content of the juice, flesh, and fruit, apricots and nectarines.—Taking the general averages of sugar in the juice of prunes and apricots we find that the prunes run over 6 per cent higher; for the whole fruit, 4.2 per cent higher. And as compared with the average French prune the apricots show for the juice some 10 per cent less sugar; and for the whole fruit, somewhat over 7 per cent less. In the whole fruit, the sugars of the apricots and plums more nearly resemble each other in amount, the average difference being 1.79 per cent in favor of the plums.

From the results at hand, it seems that the nectarine has in the juice nearly 4 per cent more sugar than the apricot, following in this respect very closely the plum.

European reports of these fruits show that the juice of prunes, on the average, contains 6.15 per cent sugar, and apricots 4.69 per cent (one case is reported of a small variety of apricots with 16.5 per cent sugar), these figures being about three times less than those herein presented for these fruits as grown in California. There seems thus to be good cause for the preference they have so quickly attained in the market.

By reference to the small table following, the relations to each other of the average sugar and acid contents of some California fruits will readily be seen. For convenience of comparison, the acid is expressed in terms of sulphuric acid (SO_3).

Sugar and acid contents of California fruits.

Fruits.	Number of analyses.	Acid.	Sugar in Juice.	Sugar in Flesh.	Sugar in Whole fruit.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Apricots	11	0.68	13.34	11.93	11.10
Prunes	23	0.40	20.00	16.11	15.35
French prunes	13	0.31	23.69	19.70	18.53
Plums	3	0.48	17.97	13.25	12.89
Peaches from Shasta and Butte Counties	2	0.24	17.00	13.40	12.50
Nectarine	1	0.62	17.17	15.13	14.11
Grapes from various localities	....	0.50	24.06	23.00	20.90
Oranges from various localities	80	1.28	10.68	7.12	5.40
Figs (white Adriatic) from Kern and Fresno Counties	2	0.15	23.90	....	19.20

Acid in the juice, prunes.—The maximum is nearly 1 per cent, the minimum 0.23 per cent, and the average 0.40 per cent. * * *

Acid in the juice, plums.—The maximum is 1 per cent, the minimum 0.20 per cent, and the average 0.48 per cent. * * *

Acid in the juice, apricots.—While the acids differ from 0.50 per cent to 0.90 per cent, they do not show as great a diversity as the prunes in this respect, but on the average contain, like the nectarine, about 0.20 per cent more acid.

In all these fruits it appears that low acids are combined with high sugars * * *

Nutritive values, nitrogen content.—[Tabular data show that] the fig rates first in flesh-forming ingredients, with little choice between the apricots and plums for second; and for third place, the prunes and oranges run nearly even. Apparently, the nectarine falls far short of the above fruits in these ingredients, but still ranges considerably higher than apples and pears (from European data only).

A tabular summary is given of the food constituents of dried commercial French prunes, apricots, grapes, and figs, identical with that given in Bulletin 97, except that analyses of two varieties of figs are incorporated. The composition of the latter is as follows:

Food constituents in dried figs.

	Figs. White Adriatic.	Figs. (European) Smyrna.
	Per cent.	*Per cent.*
Water	25.00	20.03
Ash	2.24	2.45
Crude protein	4.50	5.70
Crude fiber Nitrogen-free extract Fat	10.21	13.82
Sugar	57.60	58.00
Free acid, calculated as sulphuric (SO_3)	0.45	....
Total	100.00	100.00

Attention is called to the distribution of the nitrogen in the several portions of these fruits. First, it is readily seen that the flesh holds 85 per cent of all the nitrogen, leaving 15 per cent of it as waste, so far as food values are concerned. Second,

the distribution of the nitrogen of the pits of the prunes and apricots to the kernels and shells appears to rate on the whole about the same (12 to 1), although we note great variation in this respect in both fruits.

Ash composition and nitrogen content.—Contrary to statements in our previous publications (Bulletins Nos. 88 and 93 of the station), in which, according to European data, the orange stands second (grapes being first) among fruits in the quantity of mineral matter withdrawn from the soil, we find that, weight for weight, the fig has second place, the orange third, and the prune, apricot, and plum fourth place; thus more than ever bringing before us the fact that we can not safely use European results, as heretofore, as a basis of comparison for our fruits.

A revision of the table published in Bulletin No. 97 of the station, showing the amounts of fertilizing ingredients removed from the soil by different fruits, is given, and the data discussed. The conclusions previously drawn are not affected by the additional data.

Experiments with vegetables and fruits, 1892, W. M. MUNSON (*Maine Sta. Report for 1892, pp. 59–98, plate 1, figs. 12*).

Synopsis.—Accounts of experiments with cabbages, tomatoes, eggplants, and fruits, in continuation of those recorded in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 554). Trimming cabbage plants at transplanting gave uncertain results. Early setting of tomato plants is favored. Bagging the fruit did not promote earliness. Experiments in crossing with tomatoes and with eggplants gave interesting results. A true hybrid variety of tomatoes was produced by crossing Lorillard with Currant.

Cabbages (pp. 60–62).—Trimming off a portion of the leaves of cabbage plants at the time of transplanting gave uncertain results. Plants handled in pots before setting in the field were earlier and better than those grown in boxes. Nonesuch, a new variety, did well at the station in 1892, as in 1891. Seeds from Long Island and Washington State gave about the same results.

Tomatoes (pp. 62–75).—Plants of Early Ruby, Atlantic, New Jersey, and Beauty varieties were set in the field May 19 and June 1 and 15. A slight frost and a week of cold weather followed the first setting.

"Without exception, the average number of fruits and the average weight of the product per plant was in direct ratio with the earliness of setting, a direct confirmation of results obtained last year. The average weight of individual fruits was not essentially different in the first two settings, but was decidedly less in the last lot."

Covering clusters of fruits with paper bags did not cause the fruit to ripen earlier. Marked differences were observed in the number and weight of fruits from duplicate lots of the same varieties.

The cross between Golden Queen and Ignotum, grown in the college gardens last year, gave no indication of any influence of the yellow parent; but the second generation was decidedly variable, about half of the plants bearing red fruits and the others yellow, with no indication of the desired blush form.

A selected strain of Golden Queen having a tendency to produce fruit with a blush cheek is as yet only imperfectly fixed, but as grown in the house this tendency is very nicely brought out and the fruits are very attractive.

A cross between Ignotum and Peach tomatoes produced fruits like those of Ignotum, but in greater abundance. A cross between Loril-

lard and Peach produced fruits of intermediate size and the number of fruits was trebled. A hybrid obtained by crossing Lorillard (*Lycopersicum esculatum*) and Currant (*L. pimpinellifolium*) tomatoes is described and illustrated. The hybrid produced fruit intermediate in size and was quite prolific. The author proposes combining the hybrid with Lorillard to increase the size of the fruit. Tabulated data and descriptive notes are given for 31 varieties.

The best variety grown during the season, all things considered, was the Optimus. Among the best varieties for general use are: *Red*—Optimus, Perfection, Ignotum, Lorillard. *Pink*—Potato Leaf, Beauty, Long Keeper. *Yellow*—Golden Queen.

Of the newer varieties, Cleveland, Long Keeper, Mitchell, and Stone are desirable, while Richmond and Yellow Victor do not appear to be of special value.

Eggplants (pp. 76–89).—With a view to encouraging the more extensive growing of eggplants in Maine, methods of culture and cooking are described, and illustrated accounts are given of 8 varieties.

With careful treatment the eggplant may be successfully grown in Maine. The most important requisites of success are early sowing, vigorous plants, late transplanting to the field, warm, rich soil, thorough cultivation, and constant watchfulness for the potato beetle.

The best varieties for this latitude are Early Dwarf Purple, Early Long Purple, Long White, and possibly Black Pekin. Other large varieties are too late.

Experiments are reported with crosses of Round White with Black Pekin, Giant Round Purple with White Chinese, and Long White with Black Pekin in continuation of those recorded in Bulletin No. 26 of the New York Cornell Station (E. S. R., vol. II, p. 737):

As a result of four years of breeding, we have as yet obtained no type sufficiently constant in color to be of commercial value. We have found, however, a marked increase in vigor and productiveness as a result of crossing.

In the first generation the purple-fruited types seem stronger in their power to transmit color to the offspring than do the white-fruited types, and this law appears to hold whether the purple type is used as the male or as the female parent. In later generations the inherent strength of the white-fruited types appears more strongly than in the first, for in the third generation, after the purple type had twice entered the cross, the effect of the original white parent in imparting color to the fruits was more marked than in the first generation.

In all cases the white-fruited types appear stronger in the power to transmit form and productiveness.

Fruits (pp. 90, 91).—Brief notes on varieties planted in the station orchard and on experiments with hardy varieties at Perham in Aroostook County.

Horticultural notes, E. R. LAKE (*Washington Sta. Bul. No. 6, Oct., 1892, pp. 107–117, plate 1*).—A list of orchard and small fruits, ornamental plants, and forest trees and shrubs planted at the station. The roots of apple seedlings affected by the woolly aphis are illustrated.

Ash analysis of White Globe onions (*Connecticut State Sta. Report for 1892, p. 155*).—A reprint from Bulletin No. 108 of the station (E. S R., vol. III, p. 143).

SEEDS.

WALTER H. EVANS, *Editor.*

Examination of orchard-grass seed (*Connecticut State Sta. Report for 1892, pp. 152–154*).—Seventeen samples of orchard-grass (*Dactylis glomerata*) seed were secured for testing. Six samples were obtained from State dealers, six from Boston, and five from New York. The percentages of purity are given by weight. Duplicate tests of all seeds were made, and four tests of the first six lots. The highest result in each case is given in the following table:

Examination of orchard-grass seed.

Lot.	Weight of 1,000 seeds	Purity.	Pure seed sprouting.	Sample of seed capable of sprouting.
	Grams.	*Per cent.*	*Per cent.*	*Per cent.*
A	0.666	58.6	41.0	24.0
B	0.571	69.6	27.5	19.1
C	0.773	76.1	43.0	32.7
D	0.537	67.2	32.5	21.8
F	0.621	94.7	40.5	38.4
G	0.535	43.9	36.0	15.8
I	0.729	92.9	54.5	50.6
J	0.495	87.8	42.5	37.3
K	0.588	60.3	44.0	26.5
L	0.838	88.2	79.0	69.7
M	None.	....	....	....
N	0.609	65.7	4.5	3.0
O	0.902	98.8	35.0	34.6
P	0.555	92.0	88.0	81.0
Q	0.740	97.7	76.5	74.7
R	0.745	81.6	77.0	62.8
S	0.779	62.7	82.5	51.7

Of the 17 samples of orchard-grass seed purchased in New York, Boston, and at various places in Connecticut, one sample contained as much as 98.8 per cent of pure seed, the remainder being chaff. Another [lot M] contained no orchard-grass seed whatever, and consisted mainly of *Lolium perenne*, or other perennial rye grass. Excluding this sample, the other 16 samples contained on the average 77.4 per cent of pure seed.

Seven out of 16 samples contained notable quantities, from 8.3 to 35.5 per cent, of seed of perennial rye grass (*Lolium perenne*) which is less valuable, and sells at a lower price. "Tested" orchard-grass seed is quoted at 11 cents per pound, and "tested" perennial rye grass at 4½ cents. A single sample contained 14.1 per cent of a species of *Bromus*, probably *secalinus* or chess.

In one sample as high as 88 per cent of the orchard grass seed sprouted, in another as low as 4.5 per cent, and on the average of 16 samples, 50 per cent.

Taking the 16 samples together, the average quantity of pure orchard grass seed which was capable of sprouting was 40 per cent, *i. e.*, out of every 100 pounds bought, 40 pounds was pure, live seed. Probably the quantity that would produce healthy plants was less than this.

WEEDS.

WALTER H. EVANS, *Editor.*

Some plants injurious to stock, T. A. WILLIAMS (*South Dakota Sta. Bul. No. 33, Feb., 1893, pp. 18–44, plates 5*).—This bulletin treats of loco weeds, rattlebox, and ergot. Descriptions are given of the following plants reported as having caused the "loco" disease in cattle: *Astragalus mollissimus, A. lotiflorus, A. bisulcatus, A. haydenianus*, and *Oxytropus lamberti*. Of these, the first and the last are the most common and well known of the "loco weeds." Numerous others nearly related are to be looked on with suspicion. The symptoms of the disease and the treatment recommended in Bulletin No. 35 of the Kansas Station (E. S. R., vol. IV, p. 749) are quoted.

Rattlebox (*Crotalaria sagittalis*), a plant of wide distribution, preferring a sandy soil, is described and figured. This plant seems to be the cause of a disease of horses called "crotalism." The symptoms were fully described in Iowa Agricultural College Bulletin, November, 1884, from which copious quotations are made.

> The disease in most cases is very slow in its progress, but proves almost uniformly fatal after a number of weeks or months. There is a general decline of bodily vigor throughout this period, and the only abnormal symptom in many cases is that of marked emaciation and consequent weakness. Horses that have been kept at pasture through the summer, without work, and where the grass grew in the greatest abundance, were so thin in flesh that they walked with the greatest difficulty. A critical examination of many of these patients revealed nothing more than the conditions resulting from starvation. This was not uniformly the case. In a number of instances there was marked coma or stupor, the animal often falling asleep while eating. In some instances the animal would remain standing for a whole week, sleeping much of the time with head resting against some object. In a few instances the animals lost consciousness, and broke through fences and other obstructions. I made post-mortem examinations of five subjects with the most perfect uniformity as to the lesions presented. In every instance there were marked hemorrhagic effusions into the fourth ventricle, the liver and spleen were abnormally dense, the walls of the intestines were almost destitute of blood, and the stomach enormously distended with undigested food. The stomach, with its contents, in some instances weighed as much as 70 pounds. These post-mortem conditions, together with the clinical symptoms, led me to believe the animals were obtaining some poisonous principle with their food.

An examination of the pastures showed that the rattlebox was the only plant liable to cause the trouble. Experiments were conducted by use of a stomach pump, and an infusion of the plant was given a horse with fatal results. The symptoms of the disease and the result of the post-mortem examination were the same as in the previous cases.

The disease was especially severe during the season of 1892, some stockmen losing 15 or 20 animals of various ages. The plant is not confined to one locality, but is liable to be most abundant in rich, sandy loam in river bottoms. It yields readily to cultivation and may be

quickly destroyed by clean culture. Preventive treatment by keeping the weed from pastures and using tonics for the digestion are recommended.

Ergot (*Claviceps purpurea*) is described as occurring on species of wheat grass (*Agropyrum*), wild rye (*Elymus*), blue joint (*Calamagrostis canadensis* and *C. confinis*), reed canary grass (*Phalaris arundinacea*), and blue grass (*Poa pratense* and *P. compressa*), as well as on cultivated rye. The life history of ergot, its effect on stock resulting in ergotism, and a method of treating ergotism are given.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor*.

Some celery diseases, S. A. BEACH (*New York Sta. Bul. No. 51, n. ser., Mar., 1893, pp. 133–148, figs. 7*).—The author gives results of some investigations on the subject of celery diseases, together with collated information for the benefit of growers of this crop.

The diseases are grouped as follows: Center blight, stalk blight, and leaf spot diseases. Any disease affecting the center or heart of the celery is commonly called center blight. Two troubles of this kind are mentioned, both of which the author thinks may be due to similar causes. The first, also called soft rot, sometimes destroys the whole center, but more often appears as blotches or stripes on the tender central stalks. The spots are often preceded by a watery appearance of the tissues. In the other disease watery patches of a grayish color appear, and the leaflets wilt and finally become brown and dead. The flavor and appearance of the marketable stalks is injured at the first appearance of the disease. The disease is more prevalent during the hot summer months than in autumn, and as a consequence the early varieties suffer most. The green varieties are not exempt, but the self-blanching ones seem the most susceptible. This may be due to the greater use of such varieties for early crops rather than to any inherent reason. A hot, moist atmosphere undoubtedly hastens the spread and activity of the disease. When not too badly affected the plants may form new centers, and in favorable cases recover. This is especially true, the author finds, of young, vigorous plants.

Spraying, as a remedial remedy, has given negative results. As a precaution, the author recommends the destruction of all refuse, blanching with boards instead of earth during hot weather, experimental tests of fertilizers, and treating the seed beds so as to have settings free from leaf blight.

Stalk blight causes a withering of the leaf stalks, and is due to bacterial causes. It often starts at the place where some insect has punctured the stalk, but not always. It is not yet considered a serious injury to the crop.

Of the spot diseases, those caused by *Cercospora apii* and *Phyllosticta apii* are mentioned as occurring, and the information given is collated from Special Bulletin Q of the New Jersey Stations (E. S. R., vol. III, p. 884).

The leaf spot caused by *Septoria petroselini*, var. *apii*, is the most serious disease noticed by the author during the past season. A description of the disease and a brief account of its reported occurrence in several adjacent States are given. The author has found that the pycnidia may occur in the fruiting stalks or on the seeds themselves, and that the disease may spread from the use of affected seed. The spots may be plainly seen upon the seed and such seed should be rejected. Spraying the seed bed is urged as important and detailed results of spraying experiments are given. Dilute Bordeaux mixture and ammoniacal carbonate of copper were tested, the use of either proving highly advantageous to the young plants.

Experiments were conducted to test the value of various fungicides, the efficiency of few and frequent sprayings, and to determine the amount of copper adhering to the plant when prepared for market. Plats were sprayed with Bordeaux mixture, ammoniacal copper carbonate, and potassium sulphide solution. The applications were made twice a week, once a week, and once in two weeks. The semiweekly application gave the best results, and Bordeaux mixture was more efficient than either of the other solutions.

Analyses of a large number of specimens as prepared for market were made. They had been sprayed from one to ten times, yet in all the percentage of copper was so small that from 16,000 to 99,600 stalks would have to be eaten to secure an injurious dose of copper.

Prevention of potato scab, H. L. BOLLEY (*North Dakota Sta. Bul. No. 9, Mar., 1893, pp. 27–41*.—A report on the continuation of the investigations recorded in Bulletin No. 4 of the station (E. S. R., vol. III, p. 619), on the prevention of potato scab. Tabulated information is given of experiments with Bordeaux mixture, corrosive sublimate, and potassium sulphide to test their value as fungicides for the control of potato scab. In the field tests the corrosive sublimate, 0.003 per cent solution, gave 99 per cent of potatoes free from scab; Bordeaux mixture 55 per cent; and potassium sulphide 5 per cent. The untreated rows produced 99 per cent of scabby tubers.

Spraying experiments, W. M. MUNSON (*Maine Sta. Report for 1892, pp. 92–98*).—Experiments were conducted during the past season in two orchards for the prevention of apple scab by spraying the trees with fungicides. Three formulas were employed, viz, modified eau celeste, consisting of 2 pounds copper sulphate, 2½ pounds soda carbonate, 1½ pints ammonia, and 30 gallons water; ammoniacal solution of copper carbonate, consisting of 5 ounces copper carbonate, 3 pints ammonia, and 50 gallons water; and a third solution consisting of 3 ounces copper carbonate, 1 pound ammonium carbonate, and 50 gallons water.

Duplicate series of tests were made and tables are given showing the results.

Some of the experiments were conducted to ascertain when and how often to spray. The season was an unfavorable one for the use of fungicides, as rain fell nearly every time within twenty-four hours after spraying. The results obtained were practically the same for each orchard. The author summarizes his conclusions as follows:

(1) Spraying with copper solutions proves an effective means of checking the apple scab.

(2) The average increase in the amount of salable fruit on the trees sprayed with the least effective solution over that on the unsprayed trees was 30 per cent, while the increase on trees sprayed with eau celeste was nearly 52 per cent.

(3) Eau celeste proves more effectual than does the ammonia-copper carbonate solution, but as used there was a slight injury to the surface of the fruit.

(4) Indications point strongly to the value of spraying early in the season, before the blossoms open.

(5) Repeated applications of the fungicide during the season are beneficial.

Profit in spraying, W. J. GREEN (*Ohio Sta. Bul. No. 48, Feb., 1893, pp. 11*).—A popular report upon the use of fungicides and insecticides in the orchard and vineyard. Formulas are given for a dilute Bordeaux mixture, a copper-arsenic solution, and an ammoniacal solution of copper carbonate, with complete directions for their preparation and use. Detailed directions are given for the spraying of plums, apples, pears, quinces, cherries, peaches, raspberries, grapes, and potatoes.

The following summary is taken from the bulletin:

(1) The profit to be derived from spraying orchards often exceeds $20 per acre, and for vineyards is much more. The fruit crop of the State would be enhanced in value by several million dollars annually if the practice were generally followed.

(2) Combined fungicides and insecticides are recommended whenever applicable, because of a saving of time; a less liability of injuring foliage; greater efficiency in some cases, and as a precautionary measure in others.

(3) Dilute Bordeaux mixture, copper-arsenic solution and ammoniacal solution of copper carbonate are the most useful fungicides for the treatment of the diseases herein mentioned, and the first has the widest range of usefulness of all.

(4) Early spraying is the key to success in the use of fungicides.

(5) For the plum curculio and shot-hole fungus use Bordeaux mixture and Paris green combined, making three or four applications.

It is not known that this treatment will prevent the black knot, but cutting away and burning the diseased branches will accomplish the result.

(6) Scabby apples rot much earlier than those free from scab, and spraying with fungicides will save at least 50 per cent of this loss.

(7) Spraying with fungicides in the season of 1892 prevented much of the early dropping of apples, which is usually attributed to wet weather.

(8) For apples, two applications of Bordeaux mixture before blooming are advised, and two of the same mixture after blooming, with Paris green added.

(9) The same treatment is recommended for the pear as for the apple, before blooming, but the copper-arsenic solution is advised after blooming.

(10) The Bordeaux mixture, if used too late, causes a russet appearance on both pears and apples.

(11) The quince may be treated the same as apples, or with Bordeaux mixture alone.

(12) The treatment advised for the cherry consists in making two or three applications of Paris green, 2 ounces to 50 gallons of water.

(13) Peach trees and American varieties of plums have very tender foliage, and must be treated with very weak mixtures, if at all.

(14) Raspberries may be treated with Bordeaux mixture alone; grapes with the same until the fruit sets, after which use copper carbonate. Potatoes should be sprayed at least five times with Bordeaux mixture and Paris green.

Report of the mycologist, W. C. STURGIS (*Connecticut State Sta. Report for 1892, pp. 36–49, figs. 2*).—*Pole-sweat of tobacco* (pp. 36–39).—The experiments outlined in the Annual Report of the station for 1891 (E. S. R., vol. III, p. 773) were continued, and the value of artificial heat during unfavorable atmospheric conditions was tested. In connection with the newly organized tobacco experiment station (see p. 907), a curing barn was built at a cost of $741.93, upon the principles of ventilation suggested in 1891. It was found to be suited to the needs of this work and that the temperature could be kept at any desired degree. The barn was filled August 29 and 30, and, with the exception of three days, the weather was clear and cool throughout the period of curing. On this account the test of the barn could hardly be said to have been a very complete one. No pole-sweat was noticed, and as a result it was impossible to continue the study of the organisms producing the decay.

Experiments with potatoes (pp. 39–42).—Bordeaux mixture, ammoniacal solution of sulphate of copper, and acetate of copper were tested on a large scale as preventives for potato blight and rot. Two fields were chosen where, in previous years, the crop had suffered severely. The same varieties and cultivation were employed in each case. Paris green was added to the fungicides. The first spraying was begun June 15, and, as there was no appearance of rot owing to the dry weather, the second spraying was given on July 6. On July 16, the vines began to show blight, but no *Phytophthora* appeared on any vines, sprayed or check. The yield averaged for the plats sprayed with fungicides as follows: Sprayed with Bordeaux mixture 291 bushels, with copper sulphate solution 146½ bushels, with copper acetate 181 bushels, and with a simple solution of copper sulphate 272 bushels per acre. The general crop was considered a failure. The author's conclusions from his work are as follows:

(1) Bordeaux mixture, even of half the usual strength, viz, copper sulphate 3 pounds, lime 2 pounds, and water 22 gallons, exercises a marked effect upon potato vines, considerably increasing their vitality and period of growth.

(2) In this respect Bordeaux mixture is superior to the ammoniacal solution of copper sulphate, and to copper acetate.

(3) The ammoniacal solution of copper sulphate prepared according to Johnson's formula has one serious objection. The carbonate of ammonia is not only difficult to procure in a perfectly fresh condition, but upon exposure to the air loses water and ammonia, becoming in the course of a few days soft and opaque, in which condition considerably more of the salt is required than when fresh to dissolve the same quantity of copper sulphate. It is possible, of course, to procure the ammonia salt fresh and make up at once a sufficient quantity of the concentrated solution of copper sulphate to last during the season, but the quantity required for a season's

spraying is not often known accurately, and on the whole it would seem more convenient to use liquid ammonia as a solvent for the copper salts.

(4) The expenditure of time and labor in the application of Bordeaux mixture to potato vines, even with imperfect apparatus and methods, is much less than would be expected; the labor of three or four men for 1 hour and 20 minutes being sufficient to apply the mixture thoroughly to an acre of potatoes almost fully grown. If the mixture is prepared in the proportion of copper sulphate 6 pounds, lime 4 pounds, and water 50 gallons, the cost of chemicals would be about 28 cents per acre for each application, about 63 gallons being required to spray that area.

Quince diseases (pp. 42–44).—The experiments of former years on the value of fungicides as compared with Bordeaux mixture for leaf spot (*Entomosporium maculatum*) were continued. The fungicides tested were ammoniacal solution of copper sulphate, modified eau celeste, acetate of copper solution, copper sulphate solution, and powdered steatite. Two trees were set aside for each fungicide, and three applications were given. The trees sprayed with copper acetate in suspension seemed nearly free from rust, and this fungicide will be investigated further. None of them were in any way superior to Bordeaux mixture.

The author's attention was called to the presence of black rot (*Sphæropsis malorum*) on the fruit of quinces. The trees bearing the affected fruit had been sprayed three times with Bordeaux mixture, the last application on July 29. The rot ran rapidly through the fruit, leaving it dry and mummified and about a fourth its original bulk. Some varieties seemed more susceptible than others. As the disease did not appear until late in August, one or two additional sprayings with Bordeaux mixture would probably have prevented the attack. All mummified fruit should be removed from the trees and burned.

Celery blight (pp. 44, 45).—Powdered sulphur and potassium sulphide were tried under direction of the station, as fungicides for celery blight (*Cercospora apii*). The gardener using them claims that sulphur is the better fungicide, and that where it was dusted four times he did not lose a stalk.

A nematode disease of asters (pp. 45–49).—The author's attention was called to a disease of asters that is widespread throughout New England. In addition to asters, it appears on calendulas, marigolds, and zinnias.

As it appears in asters, the disease is first manifested when the plants are about 3 inches high. The younger portions of the plant begin to put out long, spindling shoots, which are provided here and there with dwarfed and misshapen leaves. These shoots present an unhealthy appearance, as though grown in the dark; they are of a pale yellow or whitish color, and eventually produce dwarf flowers, which, like the shoots themselves, are bleached or etiolated. From the bleached and spindling appearance of the plants, the diseased condition is known among florists as "white-legs."

One symptom which always accompanies the disease has been overlooked by those who have examined the diseased plants. At a late stage of the disease the stem of the plant exhibits signs of decay, beginning near the ground and gradually spreading upwards until sometimes the whole stem, especially the internal tissue, is involved.

The resemblance between this disease and one due to the "blue aphis" is noted, also the ineffectual use as remedies of sulphur, tobacco, and water heated to 140° F. An examination of the roots showed an abundance of minute galls containing nematodes. The decaying tissues of roots and stems were infested by the parasite, but none were found in the leaves or flowers. Specimens were submitted to Prof. G. F. Atkinson for determination, and two genera of nematodes were found, *Rhabditis* and *Aphelenchus*. The latter is probably the primary cause of the disease.

Sterilizing by heating the soil is advised, or planting in new turf soil. A simple apparatus is described for sterilizing the soil. Attention must be given to the fertilizers used. Kainit has been used successfully against nematodes, while stable manure is, as a rule, one of the poorest fertilizers that can be employed. Alkaline conditions of soil seem fatal to nematodes of all kinds. Drouth and hard freezing will also destroy them. All diseased plants should be pulled up and burned in autumn while harboring many of the worms. When advisable, on account of inability to employ other methods, the use of "catch plants" may be resorted to as a means of ridding the soil of these pests.

ENTOMOLOGY.

The bud moth, M. V. SLINGERLAND (*New York Cornell Sta. Bul. No. 50, Mar., 1893, pp. 29, figs. 8*).—During the season of 1891 the bud moth (*Tmetocera ocellana*) was the most prominent apple pest reported to the station. As it attacks the opening leaf and flower buds, it may cause serious damage, both to the fruiting and nursery stock. It is most troublesome to the apple, but it also attacks pear, plum, cherry, quince, and peach trees. The American bibliography shows that it was imported into this country about 1841, and has spread to the Missouri on the west and the District of Columbia on the south.

The pest makes its presence known early in the spring as soon as the buds begin to open, usually about May 1 on early varieties, and a week or ten days later on late varieties. Our correspondents reported that in 1891 Greening, Baldwin, and King apples suffered the most. The caterpillars work in opening fruit and leaf buds, often eating into the buds, especially the terminal ones, so that all new growth is stopped. Such work in but a few buds, on a nursery tree especially, soon checks and disfigures its symmetry of growth, and often spoils the tree for marketing. This fact makes this insect one of the worst pests to be dreaded by nurserymen. On larger trees, unless the pest is very numerous, this disfigurement of the natural growth is not so noticeable.

More often the pest does not begin its work until the buds are nearly half opened. In this case the caterpillars feed upon the central portions of the buds; if fruit buds, upon the unopened flowers. The central leaves and flowers are tied together with silken threads, and when the pest needs more food it draws in and fastens an outer leaf or flower. In a short time some of the partly eaten leaves in this nest turn brown and become detached from the branch, thus rendering the work of the pest quite conspicuous. This tying together of the leaves and flowers and the brown

appearance of many of the leaves are the most characteristic indications of the presence of the pest on large trees.

In some cases, especially on the tender shoots of young trees, the caterpillar, after destroying the bud, burrows down the center of the shoot, thus causing it to die back for several inches.

Later in the season, in July, the work of the recently hatched caterpillars may be seen on the under side of the leaves. They feed upon the lower side of the leaf near the midrib, leaving the veins and upper epidermis of the leaf. As the area over which the caterpillar has fed soon turns brown, its work is quite easily seen. The number of leaves found thus affected in July and August will indicate whether the pest will be numerous the coming spring or not.

There is nothing about the appearance of the tree itself in winter that would indicate whether the pest was present or not. As the caterpillars hibernate and are so securely hidden, it would be very difficult for an ordinary observer to find them and thus to determine whether the pest is present in alarming numbers.

The larva or caterpillar.—When first hatched, the larvæ are only about 0.04 of an inch (1 mm.) in length, slightly hairy, and of a light-green color with a dark-brown shield on the first thoracic segment; the head is nearly twice as wide as the body and of a shining dark-brown color. In a few hours the larva changes to a light seal-brown color and the head and thoracic shield become nearly black. The larvæ go into hibernation when about half grown, and appear upon the opening buds in the spring as little light-brown caterpillars, about 0.16 of an inch (4 mm.) long, with a black head and thoracic shield; the anal shield on the dorsum of the last segment is scarcely darker in color than the body.

When the larvæ are full grown they measure about one half an inch (13 mm.) in length and are of a cinnamon-brown color, with the head and thoracic shield shining black and the anal shield sometimes considerably darker than the body. Light colored hairs arising from minute dark spots on slight elevations sparsely clothe the body. The three pairs of true legs borne by the thoracic segments are black; the five pairs of pro-legs are of a fleshy nature and borne by the fourth, fifth, sixth, seventh, and last abdominal segments.

The pupa.—If the nests made by the larvæ be examined in the latter part of June the pupæ may be found in a tube of dead leaves. They are about 0.27 of an inch (7 mm.) in length and of a light-brown color. Each segment of the abdomen is provided on the dorsum with two rows of small tooth-like processes pointing caudad, and there are several hook-like bristles projecting from the caudal segment.

The moth or adult insect.—"The fore wings expand about three fifths of an inch. The head, thorax, and basal third of the fore wings, and also the outer edge and fringe, are dark ashen gray; the middle of the fore wings is cream white, marked more or less with costal streaks of gray; and in some specimens this part is ashy gray, but little lighter than the base. Just before the anal angle are two short horizontal black dashes followed by a vertical streak of lead-blue, and there are three or four similar black dashes before the apex, also followed by a streak of lead-blue.

The hind wings above and below and the abdomen are ashy gray. The under side of the fore wings is darker and has a series of light costal streaks on the outer part."

The half-grown larvæ hibernate on the twigs under a silken covering, leaving it about the time the buds begin to expand. The feeding is mostly done at night. The average period of pupation is ten days, and the moths appear about July 5 to 10 in the latitude of New York. The author found the eggs usually deposited singly on the under side of the leaves, and the period of incubation to be from seven to ten days. The summer habits of the larva and its hibernation are fully discussed. A single brood is considered the normal number, with possibly two broods

at its southern limit. The author shows that what has been taken for two broods may be explained by the fact that the larva spends part of its life in two seasons.

Three parasites have already been reported in this country as preying on the bud moth. The author mentions another, a wasp (*Odynerus catskillensis*), which uses large numbers of larvæ with which to store its egg cells.

The question of preventing the ravages of the bud moth is considered, and the author concludes the best treatment is a spray of Paris green in water or Bordeaux mixture at the rate of 1 pound to 200 gallons. The first spraying should be done before the buds have attained any considerable size, and a second should follow just before the flower buds open. As several other insects attack the orchard about this time, the two sprayings will greatly reduce all of them. It is impracticable to attempt any treatment for the eggs or adults. A July spraying may destroy some of the newly hatched brood.

The classification of insects and their relation to agriculture, O. LUGGER (*Minnesota Sta. Bul. No. 28, Mar., 1893, pp. 75–143, figs. 85*). —A popular introduction to the study of insects, together with two artificial classifications for the easy determination of the seven great groups of Hexapoda, namely, Hymenoptera, Coleoptera, Orthoptera, Neuroptera, Lepidoptera, Diptera, and Hemiptera. Each of these divisions is subdivided and so described or figured as to make it possible for one to readily determine at least the more common insects and to distinguish between the insect friend and enemy.

The author considers the subject of combating noxious insects under two heads—natural and artificial methods. In the first category he places all means employed except the use of insecticides, these being artificial. As far as possible the employment of the natural methods is preferred, as less liable to kill beneficial insects with the noxious ones. Such methods are based upon a knowledge of the habits of the insects. The principal ones mentioned are: Use of nets, traps, and baits, jarring, lights, destroying eggs, burning old rubbish, concentrating insects upon favorite food plants, high culture, rotation or omission of crops, selection of varieties, early and late sowing, plowing, mowing, introducing parasitic diseases and insects, etc.

For the artificial methods, directions are given for the preparation and application of the following insecticides: Paris green, London purple, white hellebore, pyrethrum, tobacco, soaps, kerosene emulsion, bisulphide of carbon, carbolic acid, etc.

General directions as to how and when to apply insecticides and the points to be considered in selecting spraying apparatus are given.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Proteids of the flaxseed, T. B. OSBORNE (*Connecticut State Sta. Report for 1892, pp. 132–137*).—The author separated from ground flaxseed a globulin, an albumin, a proteose, peptone-like bodies, a proteid resembling both globulin and albumin, and a proteid not extracted by sodium-chloride solution but soluble in dilute potash solution. The globulin was obtained in a crystallized form and it is believed in a pure state. Analysis showed it to agree so closely in composition with the globulin obtained from the squash seed as to leave no doubt of the identity of the two.

In pure distilled water at 20° C. this proteid, whether separated from solution by cooling or by dialysis, is wholly insoluble, while in water at 40° it is very slightly soluble. In 10 per cent sodium chloride solution it is mostly soluble, a part (Weyl's "albuminate") generally remaining undissolved, which, however, dissolves readily on warming the solution, and partly separates, on cooling, in very finely developed crystals. In glycerin diluted with water the substance separated by dialysis is wholly insoluble, either at 20° or 40°, while the substance separated from a warm sodium-chloride solution is largely soluble at 20°.

It dissolves easily in 0.2 per cent potash solution, and is thrown down by exact neutralization without change of composition or properties.

This globulin, when separated by dialysis, dissolves in 10 per cent sodium-chloride brine to a solution which, on heating, gives successively three minute coagula of other globulins at 67°, 80°, and 88°, respectively.

Saturation with sodium chloride gives a small precipitate, which consists partly of these other globulins, for the filtrate from this precipitate, when diluted so as to contain 10 per cent of sodium chloride, yields but a trace of coagulum on heating to boiling, while the precipitate itself dissolved in 10 per cent sodium chloride yields a solution which coagulates at the various temperatures observed in the solution before saturation.

Saturation with ammonium sulphate and also with magnesium sulphate completely precipitates this proteid from its solutions.

The flax albumin was obtained from the solution from which the globulin had been separated. This liquid gave no coagulum on heating unless it was concentrated to a small volume. When this coagulum was removed by dialysis a precipitate was produced in the dialyzed liquid on the addition of about 2 per cent of sodium chloride and a little hydrochloric acid. This precipitate resembled an albumin in its solubility in water, and a globulin in that when precipitated by salt and acid it formed an acid compound soluble in water nearly or wholly free from salts. It was precipitated from such solutions by neutralization with sodium carbonate. Similar substances found by Chittenden and Osborne in the maize kernel were described as albumins.

With this albumin there was precipitated a proteose closely resembling in composition the deutervitellose obtained by Chittenden and Hartwell from the crystallized proteid of the squash seed.

"The composition of the peptone and that of a small amount of proteid extracted by potash water after exhausting flax meal with sodium-chloride solution could not be determined."

All attempts to determine the amount of these various substances failed because of their change while in solution to nonproteid bodies. The author is unable to state exactly the factor for calculating the proteids in flaxseed from the nitrogen found, but from his studies is led to believe that the factor 5.55 (instead of 6.25) is not far from correct.

Crystallized vegetable proteids, T. B. OSBORNE (*Connecticut State Sta. Report for 1892, pp. 138–142*).—The author reviews the literature relating to this subject and calls attention to the lack of definite, reliable knowledge regarding the composition and properties of certain crystallized proteids. He reports the results of comparative studies on the crystallized globulins of the Brazil nut, oat kernel, hemp seed, castor bean, squash seed, and flaxseed. The crystallized globulins of the oat kernel and the Brazil nut are, he believes, distinct substances. This belief rests, aside from slight differences in composition, on differences between the solubility of the two substances in distilled water and the behavior of their solutions in brine towards sodium chloride, magnesium sulphate, and heat. The behavior of the two bodies is in each case strikingly different.

The crystallized globulins of the hemp seed, castor bean, squash seed, and flaxseed are almost identical in composition and very similar in behavior towards reagents and heat.

"It is at present impossible to assert that these four globulins are the same, but since differences exist between different preparations of globulin from the same seed as great as those found among the globulins of these different seeds, the writer is disposed to consider these four globulins as identical."

Proteids of the wheat kernel, T. B. OSBORNE and C. L. VOORHEES (*Connecticut State Sta. Report for 1892, pp. 143–146*).—The following proteids are described by the authors as occurring in the wheat kernel:

(1) A *Globulin* belonging to the class of vegetable vitellins, soluble in saline solutions, precipitated therefrom by dilution and also by saturation with magnesium sulphate or ammonium sulphate, but not by saturation with sodium chloride; partly precipitated by boiling, but not coagulated at temperatures below 100° C. The wheat kernel contains between 0.6 and 0.7 per cent of this globulin. * * *

(2) An *Albumin*, coagulating at 52°, which differs from animal albumin in being precipitated on saturating its solutions with sodium chloride or with magnesium sulphate, but not precipitated on completely removing salts by dialysis in distilled water. It was found to form between 0.3 and 0.4 per cent of the wheat kernel. * * *

(3) A *Proteose*, precipitated (after removing the globulin by dialysis and the albumin by coagulation) by saturating the solution with sodium chloride, or by adding 20 per cent of sodium chloride and acidifying with acetic acid. * * *

(4) *Gliadin*, soluble in dilute alcohol and forming about 4.25 per cent of the seed. * * * It is soluble in distilled water to opalescent solutions which are precipitated by adding a very little sodium chloride. It is completely insoluble in absolute alcohol, but slightly soluble in 90 per cent alcohol, and very soluble in 70 to 80

per cent alcohol; it is precipitated from these solutions on adding either much water or strong alcohol, especially in the presence of much salts. Soluble in very dilute acids and alkalies and precipitated from these solutions by neutralization, unchanged in properties and composition. This proteid is one on which the formation of gluten largely depends.

(5) *Glutenin*, a proteid insoluble in water, saline solutions, and dilute alcohol, which forms the remainder of the proteids of the wheat kernel, generally about 4 to 4.5 per cent of the seed. This substance is soluble in dilute acids and alkalies and is precipitated from such solutions by neutralization. * * *

Wheat gluten is composed of gliadin and glutenin. Both these proteids are necessary for its formation. The gliadin with water forms a sticky medium, which by the presence of salts is prevented from becoming wholly soluble. This medium binds together the particles of flour, rendering the dough and gluten tough and coherent. The glutenin imparts solidity to the gluten, evidently forming a nucleus to which the gliadin adheres and from which it is consequently not washed away by water. Gliadin and starch mixed in the proportion of 1 to 10 form a dough, but yield no gluten, the gliadin being washed away with the starch. The flour freed from gliadin gives no gluten, there being no binding material to hold the particles together so that they may be brought into a coherent mass.

Soluble salts are also necessary in forming gluten, as in distilled water gliadin is readily soluble. In water containing salts it forms a very viscid, semifluid mass, which has great power to bind together the particles of flour. The mineral constituents of the seeds are sufficient to accomplish this purpose, for gluten can be obtained by washing a dough with distilled water.

No ferment action occurs in the formation of gluten, for its constituents are found in the flour having the same properties and composition as in the gluten, even under those conditions which would be supposed to completely remove antecedent proteids or to prevent ferment action. All the phenomena which have been attributed to ferment action are explained by the properties of the proteids themselves, as they exist in the seed and in the gluten.

Analyses of feeding stuffs (*Connecticut State Sta. Report for 1892, pp. 147–151*).—Analyses of cotton-seed meal, cotton-seed feed, linseed meal, cream gluten, gluten meal, wheat feed, wheat bran, wheat middlings, oat feed, Western corn meal, corn-and-cob meal, hominy feed, kiln-dried starch feed, Buffalo kiln-dried sugar meal, malt sprouts, and buckwheat flour.

Practical stock-feeding, B. W. KILGORE (*North Carolina Sta. Bul. No. 90, Apr. 14, 1893, pp. 30*).—This bulletin is devoted to a practical discussion of the composition of feeding stuffs, the functions of food nutrients in animal nutrition, digestibility of feeding stuffs, feeding standards, calculation of rations, fuel value of feeding stuffs, etc. The discussions are supplemented by numerous tables showing the composition and digestibility of feeding stuffs, the digestible food nutrients in different quantities of a large number of feeding stuffs, and the results of tests of the digestibility of cotton-seed products, the last taken from Bulletin No. 87*d* of the station (E. S. R., vol. IV, p. 736).

Cattle-feeding, F. A. GULLEY and M. MOSS (*Arizona Sta. Bul. No. 8, Mar., 1893, pp. 10.*)

Synopsis.—A comparison on native steers of feeding alfalfa and sorghum alone and combined showed the best results from feeding the two together, and the next best from feeding alfalfa alone.

Alfalfa and sorghum are mentioned as the two most profitable sources of cattle food on irrigated lands in Arizona. To compare each of these feeding stuffs with the other and with a mixture of the two, three lots of 7 native steers each were fed from November 18 to January 1, seventy-one days, as follows: Lot 1, sorghum alone; lot 2, alfalfa alone; lot 3, alfalfa and sorghum mixed. They were fed in separate fields, twice daily. The sorghum was a mixture of saccharine and non-saccharine varieties. It was cut as the seed was ripening, shocked in the field, and fed whole. The amount of each food given was regulated by the appetites of the animals. During the trial the lot on sorghum gained 29.8 pounds, the lot on alfalfa 78.3 pounds, and the lot on the mixture of sorghum and alfalfa 96.4 pounds per head, showing a decided advantage from feeding the two foods together.

Following this trial, the three lots were all fed to March 1 on alfalfa alone. During this time the largest gain, 43.2 pounds per head, was made by the lot which had previously received sorghum; the next largest, 35.23 pounds, by the lot which had received alfalfa alone. The steers were very wild, so that much difficulty was experienced in weighing the individuals of each lot separately. This was done, however, on several dates. The results of these weighings show that "without exception the wildest steers in each lot made the least gains."

In this experiment alfalfa alone gives a much better result than sorghum alone, but the combination of the two is superior to either fed singly, and this is what might be expected, judging the two feeding stuffs from their chemical composition.

Sorghum—stalks, leaves, and seed—is rich in carbonaceous but deficient in nitrogenous matter for a complete food.

In considerable experience in feeding cattle with sorghum, it has always given good results, but we have always fed it with grain of some kind, or cotton seed and its products. * * * We prefer the large sweet varieties for cattle-feeding. We found this winter—and it agrees with our experience in Texas and in Mississippi—that the cattle would eat the stalks of the sweet varieties nearly clean, while of the non-sweet kinds they would eat the heads, some of the leaves, and reject most of the stalks. Feeding the two kinds together, they take the sweet first.

The article concludes with some general remarks on the care and feeding of cattle in Arizona and the results of some experiments previously made at the Texas Station and reported in Bulletins Nos. 6 and 10 of that station (E. S. R., vol. I, p. 152; II, p. 175).

Cost of milk production, H. H. WING (*New York Cornell Sta. Bul. No. 52, May, 1893, pp. 49–71, figs. 4*)—The interest which attaches to an accurate determination of the cost of producing milk and butter under ordinary circumstances led to keeping an individual record for the 20 cows of the University herd for one year, from January 15, 1892 to January 14, 1893. The food was weighed separately for each cow at each feeding and charged to the animal consuming it, and the milk was weighed at each milking and credited to the animal producing. Weekly composite samples of the milk of each cow were tested by the Babcock milk test. The cows ranged in age from 2 to over 7 years at the be-

ginning of the trial. There were 11 thoroughbred and grade Holsteins, 7 thoroughbred and grade Jerseys, and 2 common grade cows, evidently partly Shorthorn.

The plan usually followed at the station has been to have the cows in milk for about ten months each year, and the tabulated results show that this was usually the case with the cows in this trial.

The food during the winter was hay, silage, roots, wheat bran, cotton-seed meal, and corn meal. In the summer the cows were at pasture and received a liberal allowance of a mixture of wheat bran and cotton-seed meal, supplemented by soiling crops when the pasture became dry.

The tabulated results show the yield of milk and fat of each cow for one year and the yield by months, the food eaten, cost of food, consumption of dry matter in winter months, dry matter eaten per 100 pounds of milk and per pound of fat, the relative yields of the several breeds, etc. The average yield of milk for the whole year was 7,242 pounds, and of butter fat 285 pounds per cow. The milk yield varied with different animals from a little less than 3,000 pounds to over 11,000 pounds, and the butter fat from 159 pounds to 439 pounds. Making allowance for the loss of fat in skim milk and in buttermilk, it is calculated that the average annual yield of the herd was 332 pounds of butter.

The cost of milk production was based on the following prices: Hay $9, silage $1.75, roots $2, wheat bran $18, cotton-seed meal $25, corn meal $20, corn stalks $3, and grass cut and carried to cows $1.75 per ton; oats 35 cents per bushel; and pasturage 30 cents per week. On this basis the cost of food per 100 pounds of milk ranged from 44 cents to $1.48, and averaged 62.5 cents; and the cost of food per pound of fat ranged from 11 to 27 cents, and averaged 15.8 cents. The tabulation of the cost by months shows that the cheapest milk was produced while the cows were at pasture. The milk and fat both cost the most during the months of March and April, and the least in June. "We have found that in the three months of April, August, and November we have the greatest difficulty in getting a satisfactory return for the amount of food used."

The calculations of the amounts of dry matter eaten were only made for the time the cows were stall-fed (November to April). The dry matter eaten per 100 pounds of milk ranged from 74 to 148 pounds and averaged 104 pounds; and the amount consumed per pound of fat in the milk ranged from 17 to 74 pounds and averaged 27 pounds.

Our records of this herd for the year seem to us to warrant the following conclusions:

(1) With a fairly good herd, carefully fed and kept, milk can be produced for 65 cents per hundredweight and fat for 16 cents per pound as regards the cost of food consumed.

(2) That individuals of the same breed vary more widely in milk and butter production than do the breeds themselves.

(3) The larger animals consumed less pounds of dry matter per 1,000 pounds live weight per day than did the smaller animals.

(4) In general, the best yields of fat were obtained from cows that gave at least a fairly large flow of milk.

(5) In general, the cows consuming the most food produced both milk and fat at the lowest rate.

(6) For the production of milk and fat there is no food so cheap as good pasture grass.

Sheep husbandry for West Virginia, A. D. HOPKINS (*West Virginia Sta. Bul. No. 30, pp. 99–118*).—This consists of an address on profitable lines of sheep husbandry for West Virginia, which was delivered at farmers' institutes in four different places; extracts from notes taken while traveling in West Virginia and in Europe; and a summary of the answers received to a circular letter making inquiries regarding the sheep industry of the different sections of the State.

The prices of recorded rams as reported from different sections range from $5 to $75, or an average of about $25. The prices for unrecorded rams as reported, range from $2.50 to $35, or an average of about $12.

The prevailing diseases, parasites, etc., as reported, were as follows, their prevalence being indicated in the order in which they are here given: Catarrh (including what is termed rot), foot rot, grub in the head, body scab, paper skin, swelled jaw, ticks, stretches, diarrhea, head scabs, liver fluke, lung worms, anæmia, murrain, fits, maggots in wool, pulling wool, "neglect," and "starvation."

Ninety-one correspondents reported that sheep were more profitable than any other farm product; three claimed the largest profit for the dairy; one that cattle paid best, one that sheep and cattle combined were the most profitable, while thirteen did not answer.

Feeding experiments with capons (*New York State Sta. Bul. No. 53, n. ser., Apr., 1893, pp. 193–223, plates 11.*)

Synopsis.—An account of feeding experiments with capons of different breeds of fowls, comparison of capons and cockerels, and comparisons of rations having wide and narrow nutritive ratios. Caponizing is recommended as profitable. The larger breeds of fowls should be used for this purpose. Cockerels made equally as good gains as capons, but the latter commanded a higher price per pound, giving a considerably larger net profit. Corn meal and skim milk gave fully as good results as wheat bran and skim milk (narrower ration).

The breeds of fowls represented were Light Brahma, Buff Cochin, Plymouth Rock, Black Langshan, Indian Game, and crosses of Indian Game with Light Brahma and with Buff Cochin, and of White Plymouth Rock with Black Minorca. The weight of the cockerels when caponized ranged from 2.7 to 4.8 pounds, and averaged 3.8 pounds. While the lighter birds recovered from the operation much more rapidly, the heavier ones after recovery made the more rapid and profitable growth. Only one bird was lost during two years as a direct result of caponizing, and this was through lack of care after the operation. The average loss of weight from the thirty-six hours of fasting and the operation was 11.2 per cent. As a rule this lost weight was fully recovered in from five to seven days.

During the first season (1891–'92) the food given was skim milk,

wheat, corn meal, alfalfa forage, dry bone, and a mixture of 5 parts by weight of wheat bran, 1 of linseed meal, 1 of wheat middlings, and 4 of ground oats. The second season (1892-'93) it consisted of skim milk, wheat, corn, alfalfa forage, beets, corn silage, and a mixture of 5 parts by weight of corn meal, 1 or 2 parts of linseed meal, and 1 each of ground oats, wheat bran, and wheat middlings. The nutritive ratio of the food was about 1:4 or 1:5. The composition of the various feeding stuffs used is tabulated, as are also the amounts of food eaten, the gains in live weight, cost of gain, etc.

The results are graphically illustrated by diagrams, and cuts are given of capons of various breeds.

Among the author's general observations are the following:

While capons continue to command so much higher prices than the average of poultry of the same weights it will probably be found more profitable to caponize surplus cockerels of the larger breeds after the high broiler prices of spring and early summer have dropped—especially where cheap food is available. With the fancier, of course, whose time is occupied in the production of breeding and exhibition stock, the earlier the surplus chicks are disposed of, the better.

The labor required in feeding capons is less than with young chicks. The cost of caponizing is small where expert services can be obtained and an expert should be employed where possible. The methods of operation can be learned from the printed instructions accompanying several of the different sets of instruments advertised and sold, but any one endeavoring to teach himself should operate on several dead cockerels before attempting to operate on a live one. * * *

It is better, of course, to use only the larger breeds for capons. The Brahmas and Cochins are among the best, but while these breeds furnish poultry of superior size and excellent quality there is, compared to the Game, an undesirable deficiency of breast development which is plainly noticeable in the dressed fowl. * * *

A cross of the Indian Game gives nearly as large fowls as the pure breed with much of the Game shape. This cross can probably be used with advantage, for the Indian Game, while larger than the pit Game, has little of the fighting spirit of the latter, and having yellow skin and legs will not interfere with the common prejudice in that direction. * * *

Skim milk can be profitably fed to capons and if sweet in large quantities. If sour, very little should be fed. It is very important that the dishes from which milk is fed should be cleaned often and scalded occasionally.

A variety of food should be given to capons as well as to other fowls, and rations somewhat similar to those fed in these experiments will give good results. With equally good lots of birds, rations differing somewhat (but not excessively) in the proportion of nitrogenous to non-nitrogenous constituents will not make much difference in the growth. * * *

The cost of feeding capons after they have nearly reached their full size is approximately 5 cents per day for each 100 pounds live weight. The advisability of holding those of middle-weight breeds after reaching 7 to 8 pounds weight or the larger breeds after reaching 9 to 10 pounds weight will depend upon the prices to be obtained.

Cockerels vs. capons (pp. 212-218).—A lot of Buff Cochin cockerels was fed simultaneously with the Buff Cochin capons in the above trial, to compare the growth and profit. The cockerels and capons were alike in parentage, age, and previous treatment, and received similar food during the trial. The caponizing took place when the birds weighed about 4¼ pounds.

The cockerels made the more rapid growth, but consumed more food, so that at 9 pounds weight they had cost about 0.7 cent per pound more than the capons. Above 7 pounds the capons commanded about 5 cents per pound more than the cockerels. The excess of the market value of the birds over their actual cost increased quite regularly up to 9 pounds, when it averaged 37.7 cents per fowl for the cockerels, and 94.4 cents for the capons. The difference in profit was due to the higher market price which the capons commanded.

Corn meal vs. wheat bran (pp. 219–222).—Two mixed lots were fed alike, except that one lot had corn meal and the other wheat bran. The nutritive ratio of the food of the former was 1: 4.8 and the latter 1: 3.8. Both lots made profitable gains and the difference was only slightly in favor of the corn meal.

DAIRYING.

E. W. ALLEN, *Editor.*

Variations in milk, E. H. FARRINGTON (*Illinois Sta. Bul., No. 24, Feb., 1893, pp. 137–171*).

Synopsis.—The results of observations on the milk of 6 cows during one period of lactation. The butter fat was found to be the most changeable constituent. The percentage of solids-not-fat was quite uniform. Both were higher in the last part of the period of lactation than in the first part, when the milk yield was at its maximum. A gradual increase of the grain feed from 12 to 24 pounds a day per head and the change from stable to pasture feed each increased the yield of milk, but had very little if any effect on its quality. Calculations of the productiveness of cows from tests made daily and at intervals of 7, 10, 15, and 30 days are also given.

The object in view in making these observations was to study the productiveness of different cows of the herd, to note the changes in yield and composition of milk during one entire period of lactation, the changes in live weight of the cows, the changes accompanying the feeding of an unusally large amount of concentrated food, and the individual peculiarities of the cows exhibited when there was a change of food, of weather, of surroundings, etc.

There were six cows, 1 Jersey, 2 Holsteins, and 3 Shorthorns, all average animals. The trial began July 6, 1891, and ended October 14, 1892. The weighing and testing of the milk of each cow began about two weeks after calving. The milk from each milking was weighed, and a mixed sample of the morning's and night's milk of each day was tested with the Babcock machine. The milk of one cow (Jersey) was sampled and tested after each milking. Besides this an analysis was made of composite samples of each cow's milk every seven days. There were a few days during the trial on which these tests were not made, or were lost. The food of the cows from May 1 to November 1 consisted of pasturage in a blue-grass pasture with green corn fodder or dry corn fodder, hay, cracked corn, and a little oil meal as the pasture dried up.

From November 1 to December 25 they received hay, silage, broken ear corn, and linseed meal variously combined. December 25 the cows were divided into two lots to note the effect on the milk of a gradual increase of the grain ration. Lot 2 was given a ration of silage, hay, oat straw, and broken ear corn, or a mixture of corn-and-cob meal, wheat bran, and linseed meal, from which the bran was dropped toward spring. The grain ranged from 12 to 20 pounds per head. April 14 to 30 this lot received 22 pounds of hay and 6 pounds of linseed meal per head, and from that time were on pasturage alone. Lot 2 received similar kinds of coarse fodder and grain, but the grain was gradually increased from 12 to 24 pounds per head, the latter quantity being fed for two months. The change from this grain ration to pasturage alone was made gradually.

The statements given in the bulletin are average results for each cow and not the daily record. These are fully discussed and illustrated by diagrams. As showing the total production of each cow, the following

Total production and average composition of milk.

No.	Breed.	Milking period.	Total production.				Average composition of milk.		
			Milk.	Solids.	Fat.	Butter.*	Solids.	Fat.	Solids-not-fat.
		Days.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	*Per ct.*
1	Jersey	307	5,044	729	254	305	14.4	5.0	9.4
3	Shorthorn	428	6,193	794	228	274	12.8	3.7	9.2
16	Shorthorn	332	3,738	496	146	175	13.3	3.9	9.4
18	Shorthorn	342	3,069	400	115	138	13.1	3.7	9.4
4	Holstein	278	6,032	718	198	238	11.9	3.3	8.6
5	Holstein	322	7,106	885	262	314	12.4	3.7	8.7

* The butter is calculated from the butter fat in the milk by the factor 1.2.

The butter fat was the most changeable constituent of the milk. The per cent of solids-not-fat was quite uniform. Both were higher in the last part of the period of lactation than in the first when the cows were fresh and the maximum quantity of milk was produced. This was especially true of the fat. As the activity of the milk glands gradually declines until the flow of milk ceases, the formation of the fat seems to hold out better than the other constituents of the milk.

Calculated for a uniform live weight of 1,000 pounds, the production was as follows:

Yield of milk and butter per 1,000 pounds, live weight.

No.	Breed.	Age, July, 1891.	Yield for whole milking period.		Yield for 300 days.		Yield per day.	
			Milk.	Butter.	Milk.	Butter.	Milk.	Butter.
		Years.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1	Jersey	3	5,870	355	5,739	345	19.13	1.15
3	Shorthorn	3	6,069	268	4,248	186	14.16	0.62
16	Shorthorn	8	3,375	158	3,048	141	10.16	0.47
18	Shorthorn	7	2,614	118	2,292	102	7.64	0.34
4	Holstein	8	4,432	175	4,782	189	15.94	0.63
5	Holstein	8	6,742	298	6,279	276	20.93	0.92

The total amount of milk and butter produced per 1,000 pounds live weight is calculated by multiplying the yearly product by 1,000 and then dividing by the average live weight of the cow. This result divided by the number of days which the cow was milked gives the figures per day, and multiplying these by 300 shows the performance of each cow for the same live weight and length of milking period. When these cows are compared on this basis the figures for weight of milk produced, place them in the following order: No. 5 first, No. 1 second, No. 4 third, and then No. 3, 16, and 18. Comparing them as butter producers per 1,000 pounds live weight and 300 days milking period, puts No. 1 in the front rank, No. 5 second, and the others in the following order: No. 4, No. 3, No. 16, and No. 18.

The difference in value to the owner of two cows like No. 1 and No. 18, whose feed was the same, which were milked the same length of time, and were of uniform weight, but produced 345 and 102 pounds of butter, respectively, teaches a lesson in profit and loss and shows what contrasts can be often found, probably, when cows, records are investigated by weights and tests.

With reference to the effect of changes in the food of lot 2 on the yield and composition of the milk, the following table showing the digestible food nutrients eaten and the milk produced summarizes the results of this observation:

Nutrients consumed and milk produced during the several feeding periods.

Number.	Feeding periods 1891–'92.	Digestible nutrients consumed daily per head.			Yield and composition of milk.								
					Cow No. 1.			Cow No. 3.			Cow No. 5.		
		Protein.	Carbohydrates.	Fat.	Daily yield.	Composition. Solids.	Composition. Fat.	Daily yield.	Composition. Solids.	Composition. Fat.	Daily yield.	Composition. Solids.	Composition. Fat.
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*P. ct.*	*P. ct.*	*Lbs.*	*P. ct.*	*P. ct.*	*Lbs.*	*P. ct.*	*P. ct.*
1	25 days to Dec. 25	1.13	9.54	0.51	16.7	13.89	4.64	11 5	12.73	3.81	25 1	12.32	3.58
2	12 days to Jan. 6	1.94	12.63	0.77	18 4	14.44	5.24	14.8	13.14	3.76	29.0	12.43	3.88
3	27 days to Feb. 2	2.45	12.70	0.92	19.9	14.25	4.91	16.3	13.10	3.57	31.1	12.30	3.71
4	15 days to Feb. 17	2.98	14.51	1.16	19.5	14.18	4.48	16.6	13.21	3.54	30.7	12.47	3.55
5	51 days to Apr. 8	3.50	16.34	1.29	17.6	14.50	4.81	14.9	13.36	3 79	27.8	12.43	3.54
6	6 days to Apr. 14	2.73	14.08	1.08	18.6	14.45	5.00	15.2	13.12	3.70	26.2	12.10	3.39
7	16 days to Apr. 30	2.21	11.80	0.87	13.6	15.60	5.97	12.5	13.71	4.27	19.4	13.14	4.02
8	31 days to June 1	(*)	(*)	(*)	16.0	15.10	5.20	14.5	13.79	3.66	22.5	12.60	3.40

* Luxuriant blue grass pasture.

The milk of each cow increased in quantity from periods 1 to 3. This increase amounted to 3 pounds per day for No. 1, 5 pounds for No. 3, and 6 pounds for No. 5. The average per cent of solids was greater in period 2 than in 1 in the milk of Nos. 1 and 3 and but very little different in that of No. 5. The per cent of fat increased in the milk of Nos. 1 and 5 but decreased in that of No. 3 during period 2. After this time no great change in quantity or quality is noticeable in the milk of any of the cows until period 7. There was a slight decrease in the daily yields of milk during the 111 days between December 25 and April 14. This represents about one third of the period of lactation, and it is probable that there would have been a much greater decrease if the feed had been less. The table shows that the quality of the milk did not increase by this long period of feeding, which kept the quantity from decreasing, as it would naturally have done with the progress of the lactation period. There is very little difference in the per cent of solids and of fat in the milk of the second and sixth periods, although during the intervening periods a ration very rich in both protein and fat had been fed for 93 days.

The record of each cow shows the same changes in the milk in periods 7 and 8. The nutrients in the daily feed were reduced nearly to the standard in period 7. The daily milk yield of the different cows decreased from 3 to 7 pounds, but the richness of the milk increased in every case. This amounted to about 1 per cent gain in both solids and fat in the milk of No. 1, and 0.5 per cent to 1 per cent in that of Nos. 3 and 5. The difference in feed was a substitution of 10 pounds hay for 12 pounds corn-and-cob meal. This made a reduction of 1.5 pounds dry matter, 0.5 pounds protein, and 0.21 pounds fat in the daily ration per head, and a difference in the coarseness of the feed represented by a change from 18 pounds grain with 12 pounds hay to 6 pounds grain with 22 pounds hay. This ration was fed only sixteen days, and the indications are that if continued the cows would have soon gone dry in milk. When pasture feeding began there was an increase in the yield of milk from each cow. The quality of the milk decreased from what it had been during the sixteen days of period 7, which immediately preceded; but the per cent of solids and of fat in the milk was about the same in the month of May on pasture feed as it had been during the winter when the cows were stable fed on a grain ration. * * *

Twice in the period of lactation of these cows quite a sudden change was made in the flow of milk—first, when the grain fed was increased during the winter stable feeding, and, second, when the cows were turned out to pasture in the spring. * * *

The grain ration was increased December 25, and the change from stable to pasture made April 30. All the records show that the increase of feed was accompanied by a considerable increase in the pounds of milk produced and consequently in the pounds of solids, fat, and solids-not-fat in the milk; but with the exception of one or two days there were no greater changes in the percentages of fat in the milk after the increase of feed than before it was made. There was, however, a slight increase in the per cent of solids-not-fat in the milk of all the cows during the latter part of January when the increased grain ration had been fed about a month. * * *

No. 1 gave 8 pounds more milk January 4 than December 25. No. 3 increased from 11 pounds December 25 to 17½ January 9, and when she went from stable to pasture feed she gained in four days nearly 6 pounds of milk per day. The diagrams show that these changes in feed stimulated the milk production of the cows so that they each gave from 6 to 10 pounds more milk per day than they had been producing; but the quality of the milk was changed very little. The tables giving the record of each cow for the whole milking period also show that the milk was of the same uniform quality peculiar to the cow in every month, except the last ones when the cows were drying up. The average per cents of solids and of fat in the milk produced each month of the lactation periods do not show so great variations as were observed in some of the different feeding periods, which were considerably less than a month in length.

When the feed was decreased the yield of milk was diminished and the per cent of fat and solids in the milk was somewhat increased for a short time.

When the pasture is abundant the amount of feed eaten is regulated by the cow, and her milk product is probably then controlled by her natural capacity. If the quality of the milk is not changed by different amounts of grain feed from what it is on full pasture feed, it seems safe to assume from this evidence that the per cent of solids and fat in a cow's milk are not greatly influenced in one period of lactation by an increase of feed. The complete records of all these cows show some peculiarities in the milk production that are characteristic of each one and others that are common to all. *

There were a few days during the milking periods when the milk was very much richer or thinner than ordinarily, but it soon returned to the quality peculiar to the cow. An inspection of the daily weights and tests made during the whole period of lactation of each of the cows shows that four different combinations of quantity and quality can be found in the milk of some of the cows—more and richer, more

and thinner, less and richer, and less and thinner milk than was produced on the day before. Such changes were rare, but they show that it is entirely inadmissible to assert that what one cow has done in this way another always can or will do.

In connection with these observations the productiveness of the individual cows was estimated from tests made at intervals of seven, ten, fifteen, and thirty days during the period of lactation, and the result compared with those from the tests made daily. This was done to ascertain approximately how often tests should be made to judge correctly of the productiveness of an animal.

The average of all the results shows that weighing and testing the milk every seventh day gave with these six cows 98 per cent of the total milk and 98 per cent of the total butter fat; 98 per cent of the milk and 99.4 per cent of the butter fat when weighed and tested every tenth day; 97.6 per cent of the milk and 98.5 per cent of the butter fat when weighed and tested every fifteenth day; and 96.4 per cent of the milk and 97 per cent of the butter fat when weighed and tested every thirtieth day.

Analyses of creamery and private dairy butter (*Connecticut State Sta. Report for 1892, pp. 130, 131*).—Analyses of 11 samples each of creamery and private dairy butter exhibited at the meeting of the Connecticut Dairymen's Association in 1892. The average composition of these samples and a number of others reported previously, making 17 analyses of creamery and 22 of private dairy butter, is summed up as follows:

Analyses of butter.

	Creamery butter.		Private dairy butter.	
	Average.	Range of composition.	Average.	Range of composition.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Water	10.08	6.5 to 12.8	10.87	8.2 to 15.2
Salt	3.17	2.1 to 4.8	3.39	0.7 to 2.5
Curd	1.14	0.9 to 1.6	1.29	1.2 to 7.8
Fat	85.61	82.0 to 88.4	84.45	80.7 to 87.7
	100.00		100.00	

Testing cream and milk, J. M. BARTLETT (*Maine Sta. Bul. No. 4 (second series), pp. 12, fig. 1*).—This bulletin brings together for practical use the teachings of work at the various stations on the testing of milk and cream—taking the sample, measuring the acid used, using the test bottle for cream and butter, and taking specific gravity of milk—and treats of the practical application of the results of such tests at creameries, cheese factories, and condensed milk factories. The Babcock test is recommended for general use. For testing cream the bottle with separable neck, described in Bulletin No. 3 of the station (E. S. R., vol. III, p. 397), is preferred.

"The writer has designed a bottle for determining the fat in butter, made similar to the cream bottle, except the middle portion of the neck is enlarged like a pipette. The small portions above and below the enlargement are graduated the same as the milk bottles. The range

of readings is from 70 to 90 per cent fat, using 18 grams of butter. The efficiency of this bottle has not yet been tested."

Where the solids-not-fat are to be determined the author recommends the Quevenne lactometer and Babcock's formula described in Bulletin No. 31 of the Wisconsin Station (E. S. R., vol. IV, p. 193). A table is given for finding the percentage of solids not fat from the percentage of fat and the Quevenne lactometer.

The results are given of several comparisons of the gravimetric method and the method of calculation of solids-not-fat. The averages for individual milk agreed within 0.1 per cent, and usually within 0.3 per cent on mixed, watered, and skim milk.

Analyses of some American cheeses (*Connecticut State Sta. Report for 1892, pp. 156, 157*).—The following analyses are given of American cheeses. All were made in this country except the sample of Roquefort.

Analyses of American cheese.

	Water.	Ash, excluding salt.	Salt.	Protein (N X 6¼).	Fat.	Organic acids and other matters by difference.	Volatile fatty acids in 2.5 grams fat.*
	Per cent.	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*	*Per cent.*	*
Full cream cheese	34 88	2.64	1.32	23 06	35.10	3 00	....
Do	36.75	3.64		23.19	35.12	1.30	14.0
Do	35.67	2.63	1.19	24.00	34.74	1.77	15.1
Full cream cheese, old	29.87	2.80	0.99	28.31	35.62	2 41	....
Pineapple cheese:							
Yellow, 4 months old	30.95	3.29	2.34	27.00	33.26	2.16	13.4
White, 8 months old	28 01	2.96	2.14	27.12	37.25	2.52	14.0
Yellow, 16 months old	25.69	3.57	2.61	28.81	36.76	2.56	12.6
Yellow, 5 years old	11.62	4.02	1.86	34.45	45.20	2.75	13.8
Skim-milk cheese	52.15	2.45	1.70	26.31	15.35	2.04	16.5
Do	53 08	3.09	1.22	26.81	13.80	2.00	14.7
Neufchatel cheese	57.25	1.06	1.42	15.03	22.30	2.94	13.4
Fromage de Brie cheese	60.20	1.13	0.40	15.94	20.96	1.37	16.2
Imitation Old English cheese	20.74	3.68	1.47	30.12	42.72	1.27	15.8
Swiss cheese	33.79	3.22	1.85	26.12	33.25	1.77	....
Cream cheese, Crown Brand	31.40	0.45	2.72	5.25	57.98	2.20	....
Limburger cheese	42.12	1.59	3.51	23.00	29.40	0.38	14.6
Cheese made by J. Hohlridge	18.66	3.76	1.38	32.16	41.80	2.24	....
Roquefort cheese†	39.28	1.53	5.27	22.62	29.53	1.77	9.1

* Volatile fatty acids were determined by Reichert's method in 2.5 grams of the ether extract. The figures represent cubic centimeters of tenth normal potash solution required to neutralize the volatile acids. The small quantity of volatile fatty acids found in Roquefort is probably to be explained by the decomposition of fats during the peculiar ripening process.

† Imported.

Summary of results of experiments made in the manufacture of cheese during the season of 1892, L. L. VAN SLYKE (*New York State Sta. Bul. No. 50, n. ser., Jan., 1893, pp. 17–132*).—This bulletin is a summary of the experiments in cheese manufacture carried on by the station during the months of May, June, July, August, September, and October, 1892. Previous and more detailed accounts of these investigations have been reported in Bulletins Nos. 43, 45, 46, and 47 (new series) of the station (E. S. R., vol. IV, pp. 365, 426, 575). The investigations are of unusual interest, since they constitute the most extensive study of this subject ever undertaken in this country. It has been

attempted to study the various phases of cheese manufacture through the season, both at cheese factories and at the station. Accordingly, experiments lasting from three to five days in each month have been carried on at five different cheese factories within the State, and also for from two to eight days in each month at the station. In all, 106 experiments have been made, using over 200,000 pounds of milk from not less than 1,500 different cows, and manufacturing 21,731 pounds of cheese. Hence it is a reasonable claim for the results that they "represent the average conditions that prevail in New York State more closely than any other data now existing."

The bulletin contains many valuable data accumulated during the investigation, such as the averages of analyses of milk used and of whey and cheese produced under various conditions of manufacture; the relation of fat to casein, and to casein and albumin in milk; amount of different milk constituents lost and recovered in cheese-making; yield of cheese and whey, etc.

The general summary of the results of all the experiments in cheese-making during 1892 is given as follows:

Conditions of manufacture.—The amount of rennet extract used for 1,000 pounds of milk varied from 1¾ to 9 ounces and averaged 3¼ ounces. The temperature of the milk when the rennet was added varied from 82° to 90° F. and averaged a little over 84°. When the milk was in normal condition, the time of coagulation varied from eleven to forty minutes, and averaged over twenty minutes. The average degree of temperature to which the curd was heated after cutting was between 98° and 99° F. The time that passed between cutting the curd and drawing the whey varied from one to over four hours, and averaged about two hours and fifteen minutes. The time that passed between drawing the whey and putting the curd in press varied from one to over four hours, and averaged about two and one-half hours. The time occupied by the whole operation of cheese-making varied from three to over nine hours, and averaged nearly seven hours.

The composition of normal milk.—The milk solids in 100 pounds of milk varied during the season from 11.47 to 13.91 pounds, and averaged 12.66 pounds; the fat varied from 3.04 to 4.40 pounds, and averaged 3.70 pounds; the casein and albumen varied from 2.53 to 3.76 pounds, and averaged 3.14 pounds; the casein varied from 1.93 to 3 pounds, and averaged 2.48 pounds; and the albumen varied from 0.55 to 0.86 pound and averaged 0.66 pound.

For each pound of albumen in the milk the casein varied during the season from 2.6 to 4.9 pounds, and averaged 3.76 pounds.

For each pound of casein and albumen in the milk the fat varied during the season from 1.07 to 1.33 pounds, and averaged 1.20 pounds.

When the fat in the milk increased, the casein and albumen increased also, but not in the same proportion, as a rule; that is, the milk rich in fat contained somewhat less casein and albumen in proportion to its fat than did the milk poorer in fat.

For each pound of casein in the milk the fat varied from 1.35 to 1.74 pounds and averaged 1.50 pounds.

Taking the average of the entire season's results, the casein in the milk increased in just the same proportion as the fat when the latter increased. The casein averaged two thirds of the fat in amount.

In milk from which a portion of the fat had been removed there were never more than 1.09 pounds of fat for 1 pound of casein and albumen, while in most cases there was less than 1 pound of fat for 1 pound of casein and albumen. The greater the

amount of fat removed from normal milk the smaller was the amount of fat left, relative to the casein and albumen.

In milk from which a portion of the fat had been removed there were never more than 1.35 pounds of fat for 1 pound of casein, while, in most cases, there were less than 1.3 pounds of fat for 1 pound of casein. The greater the amount of fat removed from normal milk, the smaller was the amount of fat left, relative to the casein.

The greater the amount of fat added to normal milk, the greater became the amount relative to the casein and albumen together or to the casein alone.

The results secured indicate that, in the case of mixed milk of herds of cows, the milk has been skimmed if it contains less than 1.05 pounds of fat for 1 pound of casein and albumen.

According to the results secured, we should be justified in saying that, in the case of mixed milk of herds of cows, the milk has been skimmed if it contains less than 1.3 pounds of fat for 1 pound of casein.

The composition of whey.—The amount of solids in 100 pounds of whey varied during the season from 6.43 to 7.55 pounds and averaged 6.92 pounds; the fat varied from 0.22 to 0.52 pound and averaged 0.34 pound; and the casein and albumen varied from 0.67 to 1.07 pound and averaged 0.85 pound. So far as could be determined indirectly, the amount of casein in the whey averaged about 0.15 pound and the amount of albumen about 0.70 pound.

The composition of green cheese made from normal milk.—The amount of water in 100 pounds of green cheese varied during the season from 33.50 to 42.90 pounds and averaged 36.46 pounds. It was the most variable constituent of the cheese.

The fat varied from 30.84 to 37.24 pounds and averaged 34.33 pounds; the casein and albumen varied from 22.11 to 26.10 pounds and averaged 24.25 pounds; the casein (insoluble in water) varied from 20.67 to 24.37 pounds and averaged 22.68 pounds, and the soluble casein and albumen varied from 0.41 to 2.66 pounds and averaged 1.57 pounds. The albumen probably did not exceed 0.10 pound in amount.

For each pound of casein in the cheese, the amount of fat varied from 1.27 to 1.56 pounds and averaged 1.42 pounds.

In no case was the cheese made from skim milk found to contain over 1.27 pounds of fat for 1 pound of casein. The ratio of fat to casein decreased from 1.27 downward in proportion to the amount of fat removed from the normal milk.

For each pound of casein in the cheese the amount of fat varied from 1.58 pounds upward, according to the amount of fat added to normal milk.

According to the results secured in our season's work, we should be justified in saying that, in the case of cheese made from the mixed milk of herds of cows, the cheese has been made from skimmed milk if it contains less than 1.30 pounds of fat for 1 pound of casein.

Loss of milk constituents in cheese-making.—The amount of milk solids in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 5.81 to 6.83 pounds and averaged 6.21 pounds; this was equivalent to from 43.57 to 54.73 per cent of the solids in the milk, with an average of 48.60 per cent.

The per cent of the solids in the milk lost in the whey diminished as the season advanced.

The amount of fat in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 0.21 to 0.50 pounds and averaged 0.31 pounds (nearly 5 ounces); this was equivalent to from 5 to 13 per cent of the fat in the milk, with an average of 8.38 per cent.

The proportion of fat in the milk that was lost in cheese-making was entirely independent of the amount of fat in the milk. The variations in loss were due either to the condition of the milk or to some special conditions employed in manufacture.

The amount of casein and albumen in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 0.61 to 0.94 pounds and aver-

aged 0.75 pounds (12 ounces); this was equivalent to from 20.48 to 25 per cent of the casein and albumen in the milk, with an average of 23.90 per cent.

The proportion of casein and albumen lost in cheese-making was, in general, very uniform and was little influenced by variation in the conditions of manufacture.

We can not state results based upon definite data, but it is probable that in 100 pounds of milk less than 0.10 pound of albumen is recovered in cheese and that somewhat more than 0.10 pound of casein goes into the whey.

Influence of composition of milk on composition of cheese.—In cheese made from normal factory milk varying from 3 to 4.40 per cent of fat, there was a slight tendency for the fat to increase when the fat increased in the milk, but the increase of fat in the cheese was very irregular and slight, as compared with the increase of fat in the milk. Green cheese made from factory milk should contain from 32 to 36 pounds of fat in 100 pounds of cheese.

Green cheese made from factory milk should contain from 22 to 25 pounds of casein and albumen in 100 pounds of cheese. There did not appear to be any definite relation between the amount of casein and albumen in normal milk and the amount of casein and albumen in cheese made from such milk.

Influence of composition of milk on yield of cheese.—From 100 pounds of milk, there were made during the season from 8.47 to 12.44 pounds of green cheese, the average being 10.12 pounds. From 8.04 to 11.80 pounds of milk were required to make 1 pound of cheese, 9.88 pounds being the average.

The amount of water retained in the cheese made from 100 pounds of milk varied during the season from 3.16 to 5.34 pounds and averaged 3.70 pounds.

The amount of fat retained in the cheese made from 100 pounds of milk varied during the season from 2.77 to 4.11 pounds and averaged 3.39 pounds. The variation in the amount of fat retained in the cheese made from 100 pounds of milk followed very closely the variation of fat in 100 pounds of milk.

The amount of casein and albumen retained in the cheese made from 100 pounds of milk varied during the season from 1.90 to 2.82 pounds and averaged 2.39 pounds.

When there was an increase of 1 pound of fat in the cheese, there was, at the same time, an increase of 1 pound of water in the cheese and also an increase of about 0.60 pound (9½ ounces) of casein and albumen, taking the average of the season's work.

Each pound of fat produced from 2.50 to 3.11 pounds of cheese, the average for the season being nearly 2.75 pounds.

Influence of skimming normal milk and adding cream to normal milk upon the manufacture of cheese.—The per cent of loss of solids in making skim milk into cheese was greater than when normal milk was used. The per cent of loss of solids in making into cheese milk containing added cream was less than when normal milk was used. The proportion of fat in milk that was lost in making skim milk into cheese was greater than that lost in making normal milk into cheese. The proportion of fat in milk that was lost in making into cheese milk containing added cream was less than in case of normal milk. The proportion of casein and albumen lost in cheese-making was practically the same, whether skim milk, normal milk, or milk containing added cream was used.

Cheese made from skim milk contained more casein and water relative to the fat than cheese made from normal milk.

Cheese made from milk containing added cream contained less casein relative to the fat than cheese made from normal milk, and there was also a tendency to retain less water relative to the fat.

When the milk was skimmed the yield of cheese from 100 pounds of milk was diminished at least by the amount of fat removed, and generally more, according to the amount of water retained.

When cream was added to the normal milk the yield was increased at least by the amount of fat added, and generally more, according to the amount of water retained.

Comparison of Cheddar and stirred-curd processes.—The losses in manufacture were essentially the same by both processes. The Cheddar process retained in the cheese a little more water, on an average, and made a little more cheese, amounting to about 2 pounds more of cheese for 10,000 pounds of milk. No difference in quality was perceptible in the cheese made by the two processes.

Effects of using high temperature in heating curd.—The higher temperature (106° F.) caused a somewhat increased loss of milk constituents in cheese-making. The yield of cheese was diminished by the use of higher temperature. The cheese made by heating the curd at a high temperature was imperfect in flavor and lacking in firmness.

Effects of using different amounts of rennet.—When double the usual amount of rennet was used there was slightly greater loss of milk constituents in manufacture. The yield was not quite as large in proportion to the fat in the milk when the larger amount of rennet was used. The cheese made with the larger amount of rennet appeared at the end of one month to have ripened more than that made with less rennet.

Effects of cutting curd.—The loss of milk constituents in manufacture was essentially the same whether the curd was cut hard or soft. The yield was the same in proportion to the fat in the milk. The cheese was practically the same in quality.

There was a smaller loss of milk constituents when the curd was cut coarse. The yield was decidedly greater when the curd was cut coarse, owing to retention of an increased amount of water. The cheese was salvy, owing to excess of water retained.

Effects of tainted milk upon cheese-making.—The use of tainted milk in cheese-making increased the loss of milk constituents. One hundred pounds of tainted milk produced one half pound less of cheese than did good milk. The cheese was inferior in quality, being imperfect in flavor and loose in texture.

Effects of retaining natural gases in milk.—The loss of milk constituents was not increased. The yield was normal in quantity. The quality was, in most cases, perfect.

Effects of exposing milk to foul odors.—Under the conditions employed, the loss of milk constituents was not increased, but the experiments must be regarded only as preliminary and the results are not conclusive for general conditions. The yield was not affected. It was difficult to find any taint developed in the cheese, and it was perfect in body and texture.

Effects of aërating milk by separator.—The loss of milk constituents was a little greater in the separated milk. The separated milk gave a smaller yield of cheese. The cheese made from milk aërated by a separator was perfect in every respect.

STATION STATISTICS.

Reports of treasurer and board of control of Connecticut State Station (*Connecticut State Sta. Report for 1892, pp. ix–xiv*).—A financial statement for the fiscal year ending June 30, 1892, and a brief outline of the work during 1892, the details of which are reported in articles by the different officers of the station abstracted in this number of the Record.

Fifth Annual Report of Georgia Station (*Georgia Sta. Report for 1892, pp. 7*).—Brief general statements regarding the work of the station and a financial report for the fiscal year ending June 30, 1892.

Eleventh Annual Report of Ohio Station, 1892 (*Ohio Sta. Bul. No. 47, Dec., 1892, pp. vii–xli*).—This includes reports of the

board of control, treasurer (for the fiscal year ending June 30, 1892), agriculturist, entomologist, botanist, and chemist. These reports consist for the most part of brief outlines of the work of the year. A table of contents of the bulletins of 1892 is given in an appendix, and brief synopses of these are contained in the director's report. During the year the station was removed from Columbus to Wooster. Much time was spent in putting the station in order at its new location. A greenhouse and insectary erected during the year are described, and plans are given.

Fifth Annual Report of Texas Station (*Texas Sta. Report for 1892, pp. 277-285*).—Brief outline reports on the work of the station during the year 1892 by the director and agriculturist, chemist, veterinarian, horticulturist, and meteorologist, with a financial statement for the fiscal year ending June 30, 1892.

AGRICULTURAL STATISTICS.

Application of chemistry to the agricultural development of Idaho, C. W. McCurdy (*Idaho Sta. Bul. No. 3, Mar., 1893, pp. 15*).—A popular discussion of the history of chemistry, its application to agriculture, the composition of alkali soils, available crops for alkali soils, a description of the station laboratory, the lines of investigation to be followed, and directions for taking samples of water, soils, and plants for analysis.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Grasses of the Pacific Slope, part II, G. VASEY (*Division of Botany, Bul. No. 13, June 1, 1893, pp. 60, plates 50*).—This is a continuation of Bulletin No. 13 of this division, issued October 20, 1892 (E. S. R., vol. IV, p. 498). Many of the grasses are figured for the first time, and the principal synonyms are given in cases where they exist. The descriptions are by Mr. L. H. Dewey.

The following species and varieties are described and illustrated: *Agropyrum divergens*, *Agrostis foliosa*, *A. microphylla*, *Arctagrostis latifolia*, *Atropis lemmoni*, *Bromus orcuttianus*, *B. suksdorfii*, *Calamagrostis arctica*, *C. neglecta*, *C. sylvestris*, var. *longifolia*, *Coleanthus subtilis*, *Colopodium pendulinum*, *Danthonia californica*, *Deschampsia elongata*, *D. holciformis*, *Dupontia fisheri*, *D. psilosantha*, var. *flavescens*, *Elymus arenarius*, *E. condensatus*, *E. triticoides*, *Festuca microstachys*, *F. subulata*, *F. viridula*, *Glyceria pauciflora*. *Hystrix californica*, *Melica bromoides*, *M. bulbosa*, *M. frutescens*, *M. fugax*, *M. harfordii*, *M. stricta*, *Phippsia algida*, *Pleuropogon californicum*, *P. refractum*, *Poa artica*, *P. argentea*, *P. bolanderi*, *P. confinis*, *P. douglasii*, *P. fendleriana*, *P. glumaris*, *P. howellii*, *P. kelloggii*, *P. macrantha*, *P. nervosa*, *P. pulchella*, var. *major*, *P. purpurascens*, *P. thurberiana*, *P. unilateralis*, *Trisetum barbatum*, and *Uniola palmeri*.

Of this number the following are new species and varieties: *Calamagrostis artica*, *Festuca viridula*, *Poa confinis*, *P. howellii*, *P. kelloggii*, *P. pulchella*, var. *major*, and *P. unilateralis*. *Poa howellii* is described by Vasey and Scribner, *P. unilateralis* by Scribner, and the others by Vasey.

Record of experiments with sorghum in 1892, H. W. WILEY (*Division of Chemistry, Bul. No. 37, pp. 95*).—Experiments in 1892 were conducted at Medicine Lodge and Sterling, Kansas, and Calumet Plantation, Patterson, Louisiana. The end in view in these experiments was the improvement in percentage of sucrose and in purity of several varieties of sorghum.

At Medicine Lodge a parent cane of 1891, which had 17.8 per cent sucrose in the juice and a purity of 74.8, in 1892 gave 27 selections with 20.93 sucrose and 81.5 purity.

Collier led all other varieties in the average percentage of sucrose and was followed by McLean. The McLean variety ranked highest in purity, 77.99; Collier second, with an average purity of 77.13.

The Orange variety gave the largest yield per acre, 13 tons, valued at $28.60. Colman was second in this respect, yielding 9.02 tons per acre, valued at $20.75; Folger fourth, 8.72 tons, valued at $18.31; Collier sixth, 7.11 tons, valued at $16.35; and McLean thirteenth, 6.01 tons, valued at $13.22.

The report calls the attention of the stations to the large amount of seed saved from plants of high quality. The number of such selections for the four standard varieties appears in the following table:

Sugar content and purity of selected heads of sorghum.

Variety.	Total number of heads selected for propagation.	Average sucrose.	Average purity.
		Per cent.	*Per cent.*
Collier	330	20.06	82.5
McLean	391	19.20	81.7
Colman	273	17.12	80.9
Folger	516	16.18	77.4

At Sterling, Kansas, Folger was found to be the best early maturing variety, being superior to Amber in yield per acre, sugar content, and general sugar-making qualities. The Collier variety is recommended as best for the more northern latitudes in which sorghum is grown for sugar. It has abundant foliage, slender canes, and light seed heads. The McLean variety has not as yet assumed a firmly established type. "There is no variety of sorghum grown which gives as good results in the sugarhouse as the Colman. * * * The relative position of leading varieties, based on their mean percentage of sucrose, from the analysis of average samples, is as follows: Collier, 18.43; Colman, 17.79; McLean, 16.92; and Folger, 14.87. Their relative position, according to mean purity, is as follows: Colman, 77.99; McLean, 77.47; Collier, 76.02; and Folger, 72.88." As a result of five years' experiments, McLean stands first in respect to maximum sucrose and purity and minimum glucose; Colman stands second in maximum sucrose and purity and third in minimum glucose; Collier stands third in maximum sucrose and purity and second in minimum glucose; Folger stands fourth in all these respects.

Experiments were also made to determine the relative keeping qualities of the different varieties. They were cut and placed in small piles in a shady place, covered with trash and this trash kept moist.

Comparison of keeping qualities of different varieties.

Variety.	Date.	Sucrose.	Glucose.	Purity.
		Per cent.	*Per cent.*	*Per cent.*
McLean	Oct. 6	19.20	0.51	78.40
	Oct. 29	15.45	7.10	62.90
Collier	Oct. 6	20.10	0.31	76.80
	Oct. 29	17.21	6.92	66.04
Colman	Oct. 6	18.70	0.62	79.20
	Oct. 29	17.81	4.00	74.36
Folger	Oct. 6	17.70	1.03	76.70
	Oct. 29	15.28	4.23	76.17

In each instance it is seen that while there was not a great loss of sucrose, yet there was a great increase in glucose and decrease in purity.

The following table gives the average analysis of the different varieties of cane from the time they were first grown by the Department up to the present:

Average analysis of leading varieties of sorghum for different years.

Variety.	Year.	Sucrose.	Glucose.	Purity.
		Per cent.	*Per cent.*	*Per cent.*
Collier	1888	12.31	0.73	71.69
	1889	14.91	0.75	76.95
	1890	15.95	0.59	74.77
	1891	14.80	0.90	73.80
	1892	18.50	0.49	78.19
Colman	1889	14.58	1.15	75.55
	1890	14.88	0.84	76.38
	1891	15.60	0.73	76.30
	1892	16.93	0.50	77.95
Folger	1889	14.08	2.03	76.54
	1890	14.12	1.75	74.91
	1891	14.60	1.35	73.30
	1892	15.57	0.91	74.75
McLean	1890	15.22	0.52	76.00
	1891	16.40	0.55	77.40
	1892	17.24	0.47	76.85

The following table gives a comparison of varieties grown at Calumet Plantation, Louisiana:

Comparison of varieties of sorghum grown at Calumet Plantation, Louisiana.

	Colman.	Links.	Collier.	Planter's Friend.
Average sucrose, all analyses ... per cent..	18.5	16.9	17.5	16.5
Average purity, all analyses	81.4	80.1	80.0	76.2
Average non-sugars, all analyses ... per cent..	3.2	....	3.1	....
Average weight per cane ... pound..	0.95	0.76	0.65	0.82

In Louisiana a single head of Colman gave 20.3 per cent of sucrose with a purity of 81.9; another head 19.5 per cent of sucrose with a purity of 84.1.

There was a slightly greater average weight in the desuckered canes, but chemical analysis showed no difference between the desuckered and not desuckered plants.

Experiments in sirup manufacture were also made. "The process which gave the best results at this station [Sterling, Kansas,] * * * consisted in liming cold juice until a good defecation was had, and adding lime when necessary until the juice was decidedly alkaline and the color red. * * * Clay batter, like very thin mortar, was then added sufficient to increase the density of the well-stirred liquid about 1° Baumé or 2° Brix. * * * From 1 pound to 2 pounds of dry clay to 100 pounds of juice was sufficient. Yellow or brown plastic clays were found to be the best. * * * The clear liquid was then drawn off and run into a clarifying tank. Phosphoric acid was then added until blue litmus paper was slightly red, indicating faint acidity. The liquid was then heated nearly to the boiling point, skimmed and brushed, allowed to settle from half an hour to an hour, and drawn off. * * * The light-colored and clear juice was then filtered. * * * The clarified liquor was then ready for evaporation, in which there were no scums of account, for the impurities had been removed in the clarification." The amount of acid phosphate of calcium (superphosphate of lime) was about 1 gallon to 400 or 500 gallons of juice.

"The milling of the fresh cut canes required less power, and gave better extraction of juice than the milling of the wilted canes. The juice of the unstripped canes gave more bulky sediments than the juice of the canes whose leaves had been removed, while the sirup was as good in quality from unstripped as from stripped canes, and as good from fresh cut as from wilted canes."

Organization lists of the agricultural experiment stations and agricultural schools and colleges in the United States (*Office of Experiment Stations, Bul. No. 13, April, 1893, pp. 123*).—This includes a list of the governing boards and working forces of the several stations; a list of the agricultural schools and colleges, with courses of study and boards of instruction; tables showing specialists in various lines of work at the colleges and stations; the officers of the Association of American Agricultural Colleges and Experiment Stations; officers and reporters of the Association of Official Agricultural Chemists of the United States; federal legislation affecting the colleges and stations; regulations of the Post-Office Department regarding station publications; and an index of the names of college and station officers, with short biographical sketches.

Journal of Mycology (*Division of Vegetable Pathology, Journal of Mycology, vol. vii, No. 3, May 15, 1893, pp. 195–331, plates 15, figs. 3*).—Briefly summarized the contents of this number are as follows:

Experiments in the treatment of rusts affecting wheat and other cereals, B. T. Galloway (pp. 195–226).—Experiments were conducted at Garrett Park, Maryland, and Manhattan, Kansas, to ascertain (1) the effect on winter wheat of treating the soil with chemicals before planting; (2) effect of treating the seed with chemicals and hot water; (3) effect of fungicides applied in periods of two, ten, and twenty days from the

time of appearance above ground of the plants until harvest; (4) same as above on spring wheat, oats, and rye. The fungicides used were: Bordeaux mixture, ammoniacal solution of copper carbonate, ferrous ferrocyanide solution, copper borate mixture, ferric chloride solution, ferrous sulphate solution, cupric ferrocyanide mixture, cupric hydroxide mixture, potassium sulphide solution, flowers of sulphur, and sulphosteatite powder. The formulas for preparation are all given. Treating the seed and soil before planting did not reduce the rust, and in some cases was a positive injury to the crop. With our present appliances, spraying on a large scale will not pay.

Notes on peach rosette, E. F. Smith (pp. 226–232).—Investigations were conducted in Georgia on the transmission of this disease. A simple contact does not seem to be sufficient, but inoculations by buds and grafts, where there is an organic connection of tissues, will convey the disease. It can also be transmitted through the roots. Two to ten months are required as a period of incubation.

Remedies for the almond disease caused by Cercospora circumscissa, N. B. Pierce (pp. 232–339).—The use of ammoniacal solution of copper carbonate or modified eau celeste by a new formula is advised. In the new formula the ammonia is added before the salsoda and not after, as in ordinary modified eau celeste.

Experiments in preventing leaf diseases of nursery stock, D. G. Fairchild (pp. 240–264).—Experiments were conducted with Bordeaux mixture and ammoniacal solution of copper carbonate for the prevention in nursery stock of the following diseases: Pear and quince leaf blight (*Entomosporium maculatum*), cherry and plum leaf blight (*Cylindrosporium padi*), and apple powdery mildew (*Podosphæra oxycanthæ*). In every instance the use of the fungicides showed a marked effect, except in the case of the powdery mildew of the apple, where the results were negative, there being no disease on the unsprayed trees. In the other experiments Bordeaux mixture gave the best results. The use of the fungicides in most cases produced an increased growth in the stock. No general rule can be established regarding the resistant power of certain varieties.

Experiments with fungicides in the removal of lichens from pear trees, M. B. Waite (pp. 264–268).—The author found, while spraying trees for a twig disease, that applications of Bordeaux mixture cleared the trees of their foliaceous and crustaceous lichens. The stronger formula is advised where the trees can be sprayed. The application with a brush of a very strong solution is advised where the lichens are abundant on small trees.

Notes on fossil fungi, J. F. James (pp. 268–273).—Notes on various fossils of uncertain determination. Some formerly considered as fungoid and now shown to be of different origin are cited, and the identity of others is brought in question.

Descriptions of fungi (pp. 274–281).—The following new species of

fungi are described by J. B. Ellis: *Podaxon mexicanum*, *Uromyces rhyncosporæ*, *Puccinia microica*, *P. montanensis*, *P. subcollapsa*, *Uredo eriocomæ*, *U. similis*, *Tilletia rugispora*, *Asternia radians*, *Acanthostigma fraxini*, *Coniothyrium muscicolum*, *Stagonospora baccharidis*, *Septoria ampelopsidis*, *S. microspora*, *S. leucostoma*, *S. pimpinellæ*, *S. rumicis*, *Phlyctæna andersoni*, *Cylindrosporium stachydis*, *Stilbospora varneyana*, and *Tuberculina solanicola*.

Descriptions and critical notes are given by Roland Thaxter on *Urocystis hypoxyis*, *Phytophthora phaseoli*, *Gymnosporangium nidus-avis*, and *Oospora scabies*, all of which have been previously described in the publications of the Connecticut State Station.

New species of *Puccinia* and *Uromyces* are described by S. M. Tracy, as follows: *Puccinia aristidæ*, *P. pallida*, *P. redfieldiæ*, *Uromyces andropogonis*, *U. eragrostidis*, *U. panici*, and *U. hordei*.

Reviews of recent literature (pp. 282–289).—A morphological, physiological, biological, and systematic arrangement of fungi, Wilhelm Zopf; Diseases and injuries to our agricultural crops, Oscar Kirchner; and Rust in wheat, report of conference at Sydney, New South Wales, June, 1891.

Two pages are devoted to a list of errata in the previous index to literature.

The index to mycological literature is continued on pages 293–331. The index numbers run from 654 to 1002.

An agricultural survey of Wyoming, J. W. HOYT (*Division of Statistics, Miscellaneous Report No. 7, Feb., 1893, pp. 72, map 1*).—An account of the agricultural resources of the State of Wyoming and the progress and status of their development. The subjects treated are: Area and configuration of the State, soils, climate, productive areas, available water, history and results of irrigation, crops, prices of labor and products, live-stock industry, forestry, and Government helps toward development. The success of agriculture in Wyoming depends very largely on irrigation and special attention is given to this matter in the report. It is estimated that about 2,000,000 acres are now under ditches, but in 1890 only 229,000 acres were actually irrigated, of which a little over 20,000 acres were devoted to cereals.

Embracing all that portion of the country between the forty-first and forty-fifth parallels of latitude and between the one hundred and fourth and one hundred and eleventh meridians west from Greenwich, Wyoming has an area of 97,575 square miles, very nearly equal to that of New York, New Jersey, and Pennsylvania combined, or one and a half times that of all New England.

In general terms mountainous, it is not so in the same degree as Colorado, whose lofty mountains are so bunched as to constitute the dome of the continent, but with lower ranges, and those completely broken down at many points and so widely separated as to make broad valleys and plains, with a total area greater than that of any one of the older States excepting Texas, and an average elevation of about 6,000 feet above the level of the sea. * * *

Using the popular terms for their description, the soils of Wyoming, like those of the neighboring Rocky Mountain States, are about as follows: In the valleys a

sandy loam, more or less enriched and darkened by the products of vegetable decomposition; on the uplands a sandy loam, usually with a larger proportion of clay and with gravel, either fine or coarse and, where in large amount, forming a gravelly loam. In some districts there is a preponderance of heavy clay loam approaching what is commonly called "gumbo." In others there is so much sand as to make the term sandy appropriate; and in still others, as along the foot of the Black Hills on the border of Dakota, on either side of the Big Horn Mountains, and in some other districts, the gypsum formations are so prominent as to give to the soils the name of "gypsum"—"red" or "gray" according to the proportion of iron contained. * * *

Speaking broadly, there are but very limited areas in Wyoming to be classed as nonproductive. There are no vast sandy plains, alkaline flats, or other land wholly barren. Even in the poorest sections, rendered comparatively unproductive by excess of either sand or alkali, there is grass enough to afford a very considerable supply for stock; such amount in some of them as, with the protection afforded by hills and hillocks, renders them favorite resorts for cattle during the severer portions of the winter season. The mountain areas, except where the growth of timber is very dense, are grazing grounds of no little value. * * *

The total area of irrigable lands is in the neighborhood of 10,000,000 acres—greater than the combined area of Delaware, New Jersey, and Connecticut. They have an altitude ranging from 3,500 to 7,500 feet with a corresponding adaptability to the various agricultural products of the northern latitudes, some being suited to the production of corn, the semi-hardy vegetables, and fruits, while all furnish the conditions essential to the growth of the tame grasses suitable for hay. * * *

The rainfall for the plains of the State is something less than 12 inches per annum. It varies from 8.50 to 17.26 inches for the term of twenty years or more during which observations have been recorded. If this were the sole dependence there could be no farming in any proper sense. But, fortunately, there are over 20,000,000 acres of mountain area, upon which the annual precipitation, according to the estimates of the State engineer, has an average of 30 inches, giving thus a total of something like 50,000,000 acre-feet for these grand watersheds of Wyoming. It is not possible to say just how much of this is lost by evaporation and by sinking away and reappearing outside the limits of the State through the medium of subterranean channels, but we have the authority of the State engineers of Wyoming and Colorado for estimating a saving of 40 per cent. Assuming, then, that the engineers' estimate that the so-called duty of water, or requisite supply in inches, for Wyoming is 2 feet, it would appear that the total amount is sufficient to meet the demands of some 10,000,000 acres. * * * But, fortunately, Wyoming not only enjoys a larger total of precipitation than any other State within the whole arid belt, but is also favored with a wider and more equal distribution. * *

Wyoming is fortunate in the great number of natural basins—reservoirs ready made or convertible into reservoirs with but little cost. Of these the number is so great that a comparatively small proportion of the water of streams need be wholly lost.

Report of the statistician (*Division of Statistics, Report No. 104, n. ser., May, 1893, pp. 141–178*).—This includes the following articles: Condition of winter grain, mowing lands and pastures, progress of cotton planting, spring plowing, changes in crop areas, temperature and rainfall, notes from reports of State agents, the cotton crop of India for the year 1892–'93, European crop report for May, 1893, and freight rates of transportation companies.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

The influence of the pressure of gas on the development of plants, P. JACCARD (*Compt. rend.*, *116* (*1893*), *pp.* 830–833).—The author investigated the subject of the influence of the pressure of gas on plants, using for the purpose of his experiments about fifty different species, among which were wheat, lupines, radishes, corn, beans, mustard, buckwheat, onions, potatoes, *Oxalis*, *Cardamine*, primrose, daisy, *Pelargonium*, *Alisma*, veronica, junci, and iris.

Three sets of experiments were conducted, (1) in ordinary air, (2) in oxygen or air surcharged with oxygen, and (3) in a mixture of oxygen, hydrogen, and nitrogen, there being less oxygen than in ordinary air. In each experiment the plants were subjected to three pressures of gas, normal, below, and above normal.

In the air he found that at a pressure of from 10 to 40 cm. the stems of the plants grew more rapidly, were slenderer, and had a greater tendency to branch, the leaves were larger and more spreading, and the whole plant was more forward than those grown in normal conditions. Of those grown at pressures of 3 to 6 atmospheres, some showed an accelerated growth, but usually there were no morphological differences noted.

In the experiments with an atmosphere overcharged with oxygen, 35 to 90 per cent of oxygen was used. No evil effects were noticed at normal pressure, and in some plants there was an increased growth. A diminished pressure gave the same results as in the case of the air at similar pressures.

The mixture of oxygen, hydrogen, and nitrogen at a pressure of 0.5 atmosphere did not give the same result as air at the same pressure. From an anatomical point of view there were no constant differences noted in the plants due to the varied environment.

A summary is given as follows:

(1) In a general way, changes in the pressure of the atmosphere which surrounds a plant exert considerable influence on its development.

(2) The intensity and nature of the phenomena naturally vary more or less with the species, but the general curve which represents the variations of the development with the pressure has ordinarily two maxima, the first the most marked in rarefied air, the second in compressed air; the normal pressure will be found between these two maxima.

(3) The tension of the oxygen plays an important part in the phenomena; absolute pressure also plays a part.—W. H. E.

The transfer of the starch of potatoes from tubers which have made a second growth, A. GIRARD (*Compt. rend.*, *116* (*1893*), *pp. 1148–1151*).—In 1892 the author noticed a curious phenomenon, to which he calls attention. The season had been a very dry one, and the potatoes planted as usual had, in August, produced very small tubers, weighing 50 to 60 grams each. In September and October, a rainy season having set in, the potatoes began to grow. Many of the small tubers grew in the shape of an hourglass, the new growth attaching itself at the end of the tuber. In some cases. the weight of the combined tubers was 300 to 400 grams. An examination, both chemical and microscopical, showed that the starch had been transferred from the older part of the tuber, where it was in reserve, to the newer part. A table showing the per cent of starch in the old and new parts of the tubers indicates that the starch content of the new growth was from 50 to 800 per cent greater than in the older growth. A microscopical examination showed an entire absence of starch in the cells at the point of union, and an increasing amount was seen in the cells as they were farther removed from this point. The starch grains themselves showed some remarkable changes in different parts of the tuber, varying from an almost completely disorganized state to their normal condition.—W. H. E.

The influence of the starch content of the parent potato on the starch content and total weight of the crop, A. GIRARD (*Ann. Agron.*, *19* (*1893*), *No. 4*, *pp. 161–181*).—The author refers to previous experiments in which he has shown that when the season permits the normal growth of the potato there is a relation between the vigor of the foliage and the weight of the crop. By using the tubers from the hills with most vigorous foliage for seed, the cultivator is enabled to increase his harvests from year to year.

The experiments here noted are intended to test the correctness of the generally accepted hypothesis that there is a relation between the starch content of the parent tuber and the yield and starch content of the resulting crop. The author reviews the experiments on which this hypothesis rests, and, while admitting their value, regrets that the methods of experimenting used have never been published and are probably not sufficiently exact to establish the theory.

If it were true that a harvest poor in starch results from planting poor tubers, it would follow that after a season which interfered with the proper maturing of the tubers, and hence reduced the starch content, we would notice a considerable degeneration in potatoes as regards their starch content. But an experience of eight years has shown that for at least 4 varieties, YellowRose, *Vosgienne* or *Jeuxey*, Richter's Imperator, and Red Skinned, this degeneration does not exist, but that the starch content depends on the current season rather than on the preceding season.

Besides the methods of cultivation and meteorological conditions, there are three factors which can influence the crop: (1) The hereditary quality of the tubers planted; (2) their weight; and (3) their richness in food material, especially starch. The hereditary influence heretofore has been generally neglected. To overcome this hereditary influence the author selected seed tubers from the same hill for comparison.

The weight and starch content of each of the tubers from six hills (embracing four varieties) are tabulated, and these show a very wide variation between individual tubers. For example, of the thirteen tubers in a hill of the Magnum Bonum variety the poorest contained 13.9 per cent of starch, the richest 25.7 per cent. This variation is entirely independent of the size of the tubers. In one variety, the Idaho, the variation in starch content was quite small, only about 1.5 per cent, while in weight the tubers varied from 105 to 224 grams. This difference in composition between the tubers from the same plant is due to physiological phenomena which cause the tubers to mature with different rapidity, and this maturity is entirely independent of their weight.

In his experiments, the author generally used two tubers from the same plant of practically the same weight, but of different degrees of richness in starch. In every case the starch content was calculated from the density as shown by the hydrostatic balance. Fifty-three lots were harvested, and the results showed no relation between the richness in starch of the parent tuber and the quantity and quality of the resulting crop.

In another experiment each lot of seed potatoes weighed approximately 1 kilogram, and consisted of six tubers. Each lot was grown in a different locality, and the starch content of the different lots varied from 13.5 to 25 per cent. The results were exceedingly variable. Tubers with 15 per cent of starch produced practically the same crop as tubers containing 22.2 and 24.4 per cent.

The article also contains a résumé of an experiment made by M. Hébert. The starch content of 30,000 tubers was determined, and from these there were selected for planting 9,176 tubers with a starch content ranging from 12 to 20 per cent in the different experiments. The following table shows the result:

Weight and starch content of crop from seed potatoes of different qualities.

Starch content in tubers planted.	Average weight of harvest from each hill.	Starch content of crop.	Weight of crop per hectare.
Per cent.	*Kilos.*	*Per cent.*	*Kilos.*
20	1.153	19	39,895
19	1.030	21	34,312
18	1.076	20	35,505
17	1.069	21	35,626
16	0.994	17.5	33,111
15	1.064	18	35.436
14	1.027	21	34,200
13	1.048	18	34,875
12	1.039	17	34,492

This experiment carries no proof of a fixed relation between the starch content of the seed potatoes and the starch content and weight of the crop. It must be borne in mind, however, that during 1892 meteorological conditions were very unusual. The author purposes to continue his experiments.—J. F. DUGGAR.

The determination of nitrogen in soils, F. W. DAFERT (*Relat. Inst. Agron, São Paulo, Brazil, 1892, p. 107, fig. 1*).—For this purpose a modification of the Kjeldahl method is employed. The modification consists of introducing through the stopper of the distillation flask a tube, the lower end of which reaches nearly to the bottom of the flask, and the outside end connects with an apparatus supplying a current of steam which expels the ammonia from the alkaline solution. The danger from bumping is thus removed, and the time required for distillation reduced to from 6 to 10 minutes. When the soil is rich in insoluble matter, it is recommended to filter the solution obtained in the digestion flask before distillation.—W. H. B.

Cultivation of the soil and nitrification, P. P. DEHÉRAIN (*Compt. rend., 116 (1893), pp. 1091–1097*).—The determination of nitrates in the drainage water furnishes a reliable means of judging the amount of assimilable nitrogen furnished by fallow soils. The average amounts found in various soils manured and unmanured during 1891 were as follows:

Nitric nitrogen in manured and unmanured fallow soils.

1891.	Nitric nitrogen formed in one hectare.	
	Manured.	Unmanured.
	Kilos.	*Kilos*
Spring	52.21	21.87
Summer	24 79	15.21
Autumn	42.89	31.60
Winter	19.44	15.17
Total	139.33	83.94

The total amount is seen to be considerable, and is probably sufficient for the needs of vegetation, but only a small proportion of the total amount is used by crops, since each of them occupies the soil only a part of the year. In the spring especially, nitrification is slow and the supply of nitrates notably insufficient. For this reason the use of nitrate of soda is necessary and quite generally practiced at that season.

The experiments recorded in this article were undertaken for the purpose of determining whether it is possible to hasten nitrification in the spring and thus reduce the expense involved in the use of nitrate of soda.

In the spring of 1891, on examining the drainage water of soils from Seine-et-Marne, which had been placed in pots adapted to the collection of the drainage water, the following amounts of nitric nitrogen were found:

Nitric nitrogen in drainage water.

	Nitric nitrogen per cubic meter.	
	No. 1.	No. 2.
	Grams.	*Grams.*
March 24	584	539
April 7	664	466

These figures are enormous. Warington found in the drainage water at Rothamsted 10.6 grams per cubic meter; the average at Grignon was 39 grams.

Soils from Marmilhat and Palbost treated in the same way gave results as follows: Drainage water from Marmilhat soil examined July 21 contained 884 grams of nitric nitrogen per cubic meter; September 27, 250 grams; drainage from Palbost soil examined July 21, 440 grams; September 27, 285 grams.

It was observed that the drainage water was always richer at the beginning of experiments than a few months later.

These facts suggested that the increased activity of nitrification was due to the more thorough dissemination of the nitric ferments resulting from the pulverizing and stirring of the soils in filling the pots, as already pointed out by Schlösing.

To verify this point six pots which had remained undisturbed for two years on the experimental grounds at Grignon were selected. In three of these the soil was not disturbed. The other three, containing the same soil, were carried to the station building, and the soil which they contained spread out on a clean pavement which had been used for mixing fertilizers. In this condition the soil remained exposed to the air for six weeks from November 1 to December 15, and was stirred from time to time.

The soil was then taken to the laboratory and again fully exposed to the air. Samples of the exposed and undisturbed soils, taken at this time, showed the following amounts of nitric nitrogen:

Nitric nitrogen in stirred and unstirred soils.

	Nitrogen, in 100 grams of—					
	Grignon soil.		Marmilhat soil.		Palbost soil.	
	Unstirred.	Stirred.	Unstirred.	Stirred.	Unstirred.	Stirred.
	Mg.	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
No. 1	2	44	2	51	2	71
No. 2	3	39	2	46	2	57

During February these soils gave the following average amounts of nitric nitrogen per cubic meter of drainage: Unstirred soil 18.8 grams, stirred soil 1,340 grams.

In similar experiments during the winter either at ordinary temperatures or in a forcing house there was a constant but very slow increase of nitrates, the increase being from 2 to 6 mg. per hundred grams. Samples of soil similar to those which showed such energetic nitrification in November were examined in March. In spite of repeated pulverizations nitrification was irregular. The amount of nitric nitrogen in 100 grams of soil was 8 mg. in the Seine-et-Marne and Seine-et-Oise soils, and 10 to 15 mg. in Puy-de-Dome soil at ordinary temperatures, increasing to 20 to 24 mg. at a temperature of 30° C.

Thus it was observed that the soil taken for experiment in November and left in a cold room nitrified energetically after being pulverized with care, while other samples of the same soil taken in January and March and maintained under favorable conditions of moisture and temperature, generally gave medium quantities of nitrate, and at most hardly half of that obtained from the soil pulverized in November. It is evident, therefore, that the activity of the ferment is not the same at all seasons. It appears to be well established, however, that pulverization is a very effective means of promoting nitrification.

The practical deduction from these facts is that autumn cultivation of the soil may be prejudicial on account of its promoting the active formation of nitrates which will be largely washed out of the soil by the winter rains. On the other hand, thorough pulverization of the soil at seeding time will tend to increase the supply of nitrates so essential to the growing plants.

The author believes that if more thorough pulverization of the soil than that brought about by ordinary tillage is secured that it will be possible to promote activity of nitrification analogous to that obtained in the laboratory and thus produce full crops without being compelled to use nitrate of soda. Practical tests in this line are in progress and will be the subject of a future report.—W. H. B.

Trials with iron sulphate for eradication of moss in old meadows and lawns, S. Rhodin (*Kgl. Landtbruks Akad. Handlingar och Tidskrift, 30 (1891), p. 139; 32 (1893), p. 78*).—Favorable reports have been received from France in regard to the application of iron sulphate as a remedy against moss in meadows, while the results reported from Germany have mostly been unsatisfactory, the moss growing as luxuriantly after the treatment as before. On the Swedish Agricultural College grounds ten plats of 100 square meters each (1,074.7 square feet) were set apart during the seasons of 1890 and 1891 for an investigation of the subject. The plats measured out were a part of a four-year-old meadow strongly infested with moss. Five alternate plats were sprinkled with a solution of iron sulphate in water (about 1:2.5), the quantity of sulphate added ranging from 250 to 450 kilograms per hectare (220 to 400 pounds per acre). The latter quantity is higher than recommended by French writers.

The solution of sulphate was sprinkled over the plats on April 21

and November 12, 1890; immediately after the addition of the solution both grass and moss turned black, but after some rains the grass again regained its green color. The moss reappeared in the same places after both applications and was seemingly as luxuriant as before.

The sulphate seemed to slightly reduce the average yield of hay during both years, but the uneven yields from the plats make the results less important. The following table gives the main results:

Application of iron sulphate as a preventive against moss in meadows.

Plat No.	Ferrous sulphate.	Water used for solution.	Yield of hay.	
			1890.	1891.
	Kilos.	*Liters.*	*Kilos.*	*Kilos.*
1	4.5	11.25	67.0	27.0
2			67.0	9.0
3	4.0	10.00	64.5	27.0
4			73.5	29.0
5	3.5	8.75	74.0	13.0
6			74.0	38.0
7	3.0	7.50	68.0	31.0
8			64.5	27.0
9	2.5	6.25	61.5	26.0
10			60.0	29.0
Average yield from treated plats			67.0	24.8
Average yield from untreated plats			67.8	26.4

F. W. WOLL.

The efficiency of the most important chemical preservatives for manure (*Journ. Landw., 41 (1893), pp. 1–56*).—The property of gypsum in effecting the fixation of ammonia in nitrogenous organic materials, which are subject to putrefactive fermentation, is substantially assisted and increased by the presence of a sufficient quantity of free phosphoric acid and monocalcic phosphate; that is, by the water-soluble phosphoric acid.

The presence of tricalcic phosphate and of dicalcic phosphate, has no influence on the ability of gypsum to fix ammonia. The dicalcic phosphate plays no part as a transferrer of ammonia.

Superphosphate-gypsum loses some value during its use as an absorbent, the water-soluble phosphoric acid being converted into the reverted form. This loss is, however, insignificant in comparison with the advantages secured by its use.

The development of free nitrogen can be prevented without great difficulty by the exclusion of the air as far as possible and by other precautions to prevent heating of manure. The phosphoric acid in some gypsums appears to retard the processes which result in the formation of elementary nitrogen.

The Strassfurt refuse salts tend to preserve manure in the following manner: Many fermentations are suppressed; others are extended over a longer time; the ammoniacal fermentation is not hindered, but begins later, continues longer, and allows less ammonia to be formed than would occur in the absence of this salt.

As shown by one of the author's former experiments, ammonia still escapes, even when large quantities of kainit are present. These salts appear to assist the fixation of free nitrogen. Apart from this property of conserving very effectively the organic substance and of enriching the manure in potash and magnesia, kainit is not to be recommended as a means for conserving stable manure, especially since complaint is heard that by its application the hoofs of animals are injured and that manure thus treated injuriously affects certain fruits. A mixture of carnalite gives rise to the same phenomena as the addition of kainit.

The addition of kainit to superphosphate-gypsum proved beneficial. The organic substance of the fermenting material was destroyed in relatively small quantity; ammonia salts were formed in small quantities, and loss of ammonia was avoided. The fixation of free nitrogen did not occur. According to this, if kainit or carnalite is used, it is recommended always to mix them with superphosphate, since the addition of the latter seems to compensate for the injurious effect of the Strassfurt salts.

The addition of carbonate of lime to decaying nitrogenous organic material causes a strong ammoniacal fermentation and a great loss by the volatilization of ammonia.—J. F. DUGGAR.

Fertilizer experiments with sulphate of ammonia and nitrate of soda for barley and oats, S. RHODIN (*Kgl. Landtbruks Akad. Handlingar och Tidskrift, 30 (1891), pp. 142–148; 32 (1893), pp. 78–82*).—The experiments were made on the experimental grounds of the Swedish agricultural college, and were intended to throw additional light on the question of the relative value of nitrate and ammonia-nitrogen for the cereals. Numerous plat experiments with potatoes, sugar beets, and mangel-wurzels, both in England and in Germany, have shown that nitrate-nitrogen is considerably more effective for those crops than ammonia-nitrogen. The results obtained in experiments with the cereals are, however, conflicting. Lawes and Gilbert found that 100 pounds of nitrate-nitrogen increased the yield of barley and wheat by 50 pounds of grain and 100 pounds of straw above the yield secured by the application of the same quantity of ammonia-nitrogen. Maercker and P. Wagner, on the other hand, found that sulphate of ammonia and nitrate of soda have about the same value as fertilizers for the cereals. Maercker experimented with barley and oats, and Wagner with oats, rye, and a large number of other crops.

The author chose barley and oats for his experiments. The soil was a heavy clay, rich in potash and phosphoric acid, for which reason these ingredients were not supplied. The land, which had been in grass for some years past, had not received any barnyard manure during the eight preceding years. The nitrate of soda and the sulphate of ammonia were supplied at the rate of 27 and 45 kilograms of nitrogen per hectare (24 to 40 pounds per acre), three plats receiving the smaller quantity and three the larger; two plats during 1890 and three during

1891 received no fertilizer of any kind. No information concerning the size of the plats is given in the account of the experiments, all yields having been calculated per hectare. The following summaries are deduced from the data published, giving the yield of each plat, weight of cereals, and value of fertilizer applied:

Experiments with barley and oats during 1890 and 1891.

	Yield per hectare.					
	With smaller application.			With larger application.		
	Nitrate of soda.	Sulphate of ammonia.	Difference in favor of sulphate of ammonia.	Nitrate of soda.	Sulphate of ammonia.	Difference in favor of sulphate of ammonia.
Season of 1890:	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*
Barley:						
Grain	2,131.30	2,167.00	+ 35.7	2,285.70	2,106.80	—178.9
Straw	4,500.00	4,380.00	—120.0	5,293.90	4,774.50	—519.4
Oats:						
Grain	1,718.75	1,798.75	+ 80.0	1,981.25	2,106.25	+125.0
Straw	4,281.25	4,576.25	+295.0	5,018.75	5,456.25	+437.5
Season of 1891:						
Barley:						
Grain	2,151.66	1,812.66	—339.0	1,970.66	1,769.66	—201.0
Straw	2,990.66	2,377.66	—613.0	2,873.33	2,400.33	—473.0
Oats:						
Grain	2,150.66	2,253.66	+103.0	2,360.66	2,363.66	+ 3.0
Straw	2,998.33	3,133.66	+135.33	3,188.33	3,112.00	— 76.33

The results indicate in general that the application of nitrogen in the form of ammonium sulphate is more favorable in case of oats than in case of barley, as compared with similar application of nitrogen in the form of nitrate of soda. The weather was unfavorable during both years, and caused an uneven growth on the different plants. If we take the averages of the results for both years we find that barley did not respond as well to the application of sulphate of ammonia as to that of nitrate of soda, and this held good in case of both the smaller and the larger quantity of fertilizers applied. With oats the reverse is true, the sulphate of ammonia proving somewhat more effective when either quantity of fertilizers was applied.

The following statement has been calculated from the tables published in the article, and will show the relative effectiveness of nitrogen in the two forms for barley and oats, the results from both years' experiments being considered:

Increase in yield of barley and oats from sulphate of ammonia above the yield from nitrate of soda.

	24 pounds of nitrogen per acre.	40 pounds of nitrogen per acre.
Barley:	*Per cent.*	*Per cent.*
Grain	—7.1	— 8.9
Straw	—9.8	—12.2
Oats:		
Grain	+4.7	+ 3.4
Straw	+5.9	+ 4.4

F. W. WOLL.

Experiments in the culture of the horse bean, BRUMMEL (*Deut. landw. Presse, 1893, No. 40, pp. 437, 438*).—In experiments continued through three years and designed to ascertain the best distance between the rows, a distance of 35 cm. gave the maximum yield of beans. At a distance of 50 cm. the yield fell about 14 per cent below the maximum; when the rows were alternately 10 cm. and 50 cm. apart the yield was 3.6 per cent less than the maximum; at alternate distances of 45 and 15 cm. the loss in yield was 2.8 per cent. The greater ease of culture where alternate rows are wide offsets this slightly decreased yield.

The following table gives the yields of the weedy plats and those kept free from weeds:

Yield of beans from weedy and clean plats.

	Yield per hectare.		Relative yield of weedy plats, reckoning yield of each clean plat at 100.
	Weedy.	Free from weeds.	
	Kilos.	*Kilos.*	
Experiment I	2,670	3,850	69.3
Experiment II	1,870	3,900	47.4
Experiment III	2,900	3,600	80.0
Experiment IV	2,180	3,690	59.2
Experiment V	2,600	3,730	70.0
Experiment VI	1,990	2,580	77.0
Experiment VII	870	2,170	40.0

While the yield of beans was much reduced by the presence of weeds, the yield of coarse forage was not reduced.

A test of drill culture against broadcasting gave a somewhat higher yield with the former.

Where weeding was not practiced the earlier plantings were more injured by weeds than later plantings. For fields that are not to be carefully hand-hoed the author recommends rather late planting, a large quantity of seed, shallow covering, and harrowing when the plants are from 5 to 7 cm. high. Soaking caused the seed to sprout three or four days earlier.—J. F. DUGGAR.

Effect of removing the leaves of the sugar beet, H. BRIEM (*Wochenschr. Central Ver. Rübenzuck. Ind., 1893, No. 2, p. 16*).—The author calls attention to experiments which indicate that beets stripped of their older leaves before harvest give a smaller yield than when the older leaves are allowed to remain on the plants. In one experiment not only was there a loss in total weight, but there was also an average loss of 2.03 per cent in the sugar content, and a considerable increase in the per cent of ash as the result of removing these leaves.—J. F. DUGGAR.

The influence of parasitic fungi upon their host plants, J. F. WAKKER (*Prings. Jahrb. Bot., 24, pp. 499–548; abs. in Bot. Centralbl., 54, No. 5 and 6, pp. 184, 185*).—With reference to their influence

on their host plants, the author divides parasitic fungi into four groups, as follows: (1) Kteinophytes, which produce chemical changes resulting in the death of the cells; (2) Hypertrophytes, causing a hypertrophied condition of the part of the host attacked; (3) Isotrophytes, producing little or no effect on the host plant; (4) Atrophytes, producing atrophy of important organs, usually the flowers.

Exobasidium vaccinii, 8 species of *Uredineæ*, *Cystopus canadensis*, *Peronospora parasitica*, *Exoascus pruni*, *E. alnitorquus*, *Urocystis violæ*, *Ustilago maydis*, and *Plasmodiophora brassicæ* were examined upon many hosts. The author conducted his experiments along the line of the second group, studying the Hypertrophytes.

The effect produced by this group on their host plants is as follows: The young plants do not show the affection as plainly as the older ones. In them the parasite prevents the formation of primary, or at least secondary, tissues. The mechanical tissues, collenchyma, and bast and stone cells, are interfered with, and the pith cells are compressed and lignified. The secondary fibrovascular bundles generally remain imperfect, while the transverse walls are not absorbed. These bundles are widely scattered and more or less tortuous and irregular. In many cases only a microscopical examination would reveal the presence of the fungus.

In the hypertrophy of *Plasmodiophora brassicæ* the fibrovascular bundles are deficient in number and the usually strongly developed xylem is replaced by parenchyma cells. The intercellular spaces in the hytrophied organ are often much greater or much less than in the normal organs.

Referring to the cell contents, the author found that the chromatophores in hypertrophy frequently have only a partial development, and there is a similar deficiency in calcium oxalate crystals. On the contrary, the author found in hypertrophy, as well as in the parts of plants affected with isotrophy, an enormous amount of starch.

The characteristics of parts of plants under the influence of parasitic attacks according to the author are the enlargement of cells; coloring of cell sap; the formation of chlorophyll in parts of the flowers usually without chlorophyll; the formation of clusters of crystals; the appearance of the accessory fibrovascular bundles; and the external development of meristem and sclerenchyma. The author calls attention to the resemblance between hypertrophied and etiolated organs.—W. H. E.

The influence of copper compounds on the grape, C. RUMM (*Ber. deut. bot. Ges., 10, No. 2, pp. 79–93*).—The author begins his paper by giving a résumé of the opinions of a large number of investigators on the value and effect of the use of copper preparations for the suppression of the downy mildew of the grape (*Peronospora viticola*).

During the season of 1892 he investigated the subject, using Bordeaux mixture as the fungicide. Frequent sprayings were given the vines before the time of blooming (June 9), after which no sprayings were given. September 20 a warm period set in, followed, October 10, by a rainy season.

Designating the sprayed vines as A and the unsprayed as B, the results of his experiments are as follows: The leaves of A remained darker green than those of B, the difference in color being very marked at the beginning of August. The sprayed vines were in flower on June 17, while the others were not. On September 12 the clusters of A were becoming ripe, while those of B were considerably later.

On September 16 three leaves were cut, one sprayed and one unsprayed from A and one from B, and their petioles placed in water. Three days later the sprayed leaf was still fresh, the unsprayed one from A was slightly wilted, while the leaf from B was about half dried up. October 18 eight leaves were taken, four from A and four from B, and subjected to the same conditions. At the end of a week all the leaves from A were still green and showed but little change, while those from B were discolored and more or less dried up.

A microscopical examination was made of the leaves to see if there had been any changes in them due to the use of the copper salts. In every case the sprayed leaves were thicker than the unsprayed ones. The increase in thickness as shown by 128 measurements was from 2.17 to 16.31 μ, and this increase was not confined to any particular region of the leaf. The chlorophyll was more abundant both in the palisade and spongy parenchyma of the leaves, and the air spaces less numerous in the sprayed leaves than in the unsprayed. The author thinks the conclusion of Alessandri,* that the chlorophyll takes on a more intense color, due to copper salts, is not warranted, but that the darker color of the leaves is due to a greater amount of chlorophyll present in them. The increased chlorophyll formation is probably due to the copper acting as a chemical stimulus without any of the salt being taken up by the leaves. Of course an increased chlorophyll production results in a greater starch formation, which in turn has a direct effect upon the fruit. The author also found that the transpiration was lower in the sprayed than in the unsprayed vines.

Chemical tests were made to determine whether the leaves had taken up any of the copper and whether any of it remained in a soluble condition on the leaves. All the copper found was in the form of the insoluble hydrate.

The author concludes that there is no doubt that timely and suitable spraying of grapevines is of the highest importance. On the one hand, it reduces the spread of the fungus, and on the other, as shown from his experiments, it is of direct advantage to the vines. Under similar conditions the sprayed vines set more fruit and on sound stocks were at least two weeks earlier in ripening their grapes than the unsprayed. The artificial hastening of the ripening of grapes will doubtless prove valuable in many locations, especially in southern Germany. Whether this artificial hastening can be continued without final

* Alessandri, L'Italia agricola, a XXI, Milano, 1889.

injury to the plant or whether it may not be of permanent advantage remains to be seen. There still remains the question whether or not the continued application of copper sulphate will not leave so much copper in the soil that through the plant there would be a serious element of danger. The investigations of Haselhoff* with water cultures show that there is such a danger. On the other hand, through the presence of calcium carbonate in the soil the evil influence of copper sulphate and copper nitrate is diminished so long as there remains undecomposed lime in the soil. When this is exhausted the effect will be the same as in the calcium-free soils. It still remains to determine a practical manner in which the evil influence of the copper may be prevented.—W. H. E.

Fourth Annual Report of the Halle Station for experiments in the repression of nematodes and for plant protection, 1892, M. HOLLRUNG (pp. 60).—During the season more than five hundred experiments were conducted at the station, the results of which are given. The spring season was very backward, the low temperature extending through May. In addition to the cool weather the season was very dry, there being but about 10 inches of rainfall from March to October, inclusive.

The experiments of 1891 (E. S. R., vol. III, p. 820) on ridding the soil of nematodes, through the cultivation of catch plants and crops of potatoes, were continued very successfully. A tabulated report of experiments with 9 varieties of potatoes, planted after catch plants, is given. They were of early, medium, and late sorts and were compared with similar lots planted in the usual ways. In every case the yield was less when planted after catch plants, but was sufficiently large to more than pay for the expense of both crops. The time of planting the first crop of catch plants was about April 1, and the second crop about six weeks later. There was no particular advantage gained by using early varieties of potatoes, as some of the later ones gave larger yields.

The use of alkaline fertilizers for the beet nematode (*Heterodera schachtii*) and the influence of the fertilizers on the soil were further investigated, as was the freeing of the diffusion residue from nematodes. It was again found that alkaline solutions were beneficial in destroying the nematodes.

The author devotes a considerable portion of the report to a "root rot" of young beets. It is usually attributed to attacks of a species of *Atomaria*, but in a number of specimens examined no *Atomaria* was found, but there was an undetermined fungous mycelium present in many. The disease begins with the epidermis and almost always cuts nearly through the root. Of a large number of small plants examined, from 10 to 50 per cent of those under one half millimeter in diameter were

* Haselhoff, Landw. Jahrb., 21 (1891), p. 261.

affected by this disease. That the disease is well known and widely scattered is shown by replies of beet growers to the author's inquiries. From the correspondence he finds the disease is worse during cold and moist weather, and he thinks it may be prevented by the use of phosphoric acid on the soil.

A patented powder, called "The Beet Protector," was tested during the past season. It was claimed that it would protect the beet against all its enemies, but was shown to be of no particular value.

Tabulated information is given regarding the use of Bordeaux mixture, and German and Belgian copper steatite on 11 varieties of potatoes for the prevention of potato rot (*Phytophthora infestans*). The disease was not at all serious on the untreated plants, owing possibly to the dry season. Taking into consideration the cost of materials and application, the author considers the copper steatite, especially the German, the better fungicide.

The report concludes with an enumeration of a number of insect and fungous enemies of the common field crops, with brief notes concerning each.—W. H. E.

An investigation of Swedish fodder plants, A. G. KILLGREN and L. F. NILSON (*Kgl. Landtbruks Akad. Handlingar och Tidskrift, 32 (1893), pp. 88–106*.—A continuation of the investigations described in vol. 32, pp. 1–32 of the same journal, and reviewed in E. S. R., vol. IV, p. 768. The authors give complete chemical analyses of five phænogamous and four cryptogamous plants from northern Sweden, which are used more or less extensively as fodder plants. The analyses are accompanied by a discussion of the results and of the economic value of the fodders, their distribution, and adaptability as food for the various farm animals, etc.

The following table shows the composition of the fodders analyzed. As before, the analyses of fodders belonging to the same family are grouped together.

Composition of Swedish forage plants.

Species.	Moisture.	Ash.	Crude protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.
1. Lady's mantle (*Alchemilla vulgaris*, L.):	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Air dry	10.46	7.46	11.81	3.70	13.42	53.15
Dry		8.33	13.19	4.13	14.99	59.36
2. Willow herb (*Epilobium alpinum*, L.):						
Air dry	9.68	10.25	13.94	3.26	12.18	50.69
Dry		11.35	15.43	3.61	13.49	56.12
3. Cow wheat (*Melampyrum pratense*, L.):						
Air dry	7.73	7.28	11.13	1.54	22.21	50.11
Dry		7.89	12.06	1.67	24.07	54.31
4. False lettuce (*Mulgedium alpinum*, L.):						
Air dry	10.34	14.50	12.94	3.08	18.09	41.05
Dry		16.17	14.43	3.43	20.18	45.79
5. Chickweed (*Stellaria graminea*, L.):						
Air dry	8.08	5.46	10.00	1.93	22.66	51.87
Dry		5.94	10.88	2.10	24.65	56.43
Average for dry matter in 1–5		9.94	13.20	2.99	19.47	54.40

Composition of Swedish forage plants—Continued.

Species.	Moisture.	Ash.	Crude protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.
6. Horsetail (*Equisetum fluviatile*, L.):	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Air dry	8.36	16.07	9.69	1.44	18.41	46.03
Dry	....	17.54	10.57	1.57	20.09	50.23
7. *Equisetum palustre*, L:						
Air dry	8.46	15.72	14.50	2.25	13.25	45.82
Dry	....	17.17	15.84	2.46	14.48	50.05
Average for dry matter in 6-7	....	17.36	13.20	2.02	17.28	50.14
8. Mary's grass (*Cetraria nivalis*, L.):						
Air dry	10.54	0.77	1.94	3.19	2.37	81.19
Dry	....	0.86	2.17	3.57	2.65	90.75
9. Reindeer moss (*Cladonia rangiferina*, L.):						
Air dry	9.16	0.54	1.66	1.70	86.94	
Dry	....	0.59	1.83	1.87	95.71	
Average for dry matter in 8-9	....	0.72	2.00	2.72	94.56	

Amount and digestibility of nitrogen in Swedish forage plants.

Species.	Nitrogen.			
	Total.	Amide.	Digestible.	Per cent digestible.
1. Lady's mantle (*Alchemilla vulgaris*, L.):	*Per cent.*	*Per cent.*	*Per cent.*	
Air dry	1.89	0.35	1.77	93.6
Dry	2.11	0.39	1.98	....
2. Willow herb (*Epilobium alpinum*, L.):				
Air dry	2.23	0.46	2.07	92.8
Dry	2.47	0.51	2.29	....
3. Cow wheat (*Melampyrum pratense*,, L.):				
Air dry	1.78	0.16	1.05	59.0
Dry	1.93	0.17	1.14	....
4. False lettuce (*Mulgedium alpinum*, L.):				
Air dry	2.07	0.51	1.74	84.0
Dry	2.31	0.57	1.94	....
5. Chickweed (*Stellaria graminea*, L.):				
Air dry	1.60	0.26	1.28	80.0
Dry	1.74	0.28	1.39	....
Average for, dry matter in 1-5	2.11	0.38	1.75	81.9
6. Horsetail (*Equisetum fluviatile*, L.):				
Air dry	1.55	0.33	1.28	82.6
Dry	1.69	0.36	1.40	....
7. *Equisetum palustre*, L.:				
Air dry	2.32	0.25	2.05	88.3
Dry	2.53	0.27	2.24	....
Average for dry matter in 6-7	2.11	0.32	1.79	85.4
8. Mary's grass (*Cetraria nivalis*, L.):				
Air dry	0.31	0.07	0.17	54.8
Dry	9.35	0.08	0.19	....
9. Reindeer moss (*Cladonia rangiferina*, L.):				
Air dry	0.27	0.07	0.16	59.2
Dry	0.29	0.08	0.17	....
Average for dry matter in 8-9	0.32	0.08	0.18	57.0

The plants given in the above table are all used as fodders in parts of Sweden, and some of them are highly prized as such. The small quantity of protein in the two lichens is remarkable when we consider the fact that they form the sole food for both the tame and the wild reindeer during part of the year. The authors show that the quantities of reindeer moss which the animals would have to eat daily in order to obtain the amounts of nutrients called for by German feeding standards, decidedly exceed the capacity of the animals. Both lichens are

gathered in the fall and fed to cattle and sheep; the reindeer moss is relished especially by cattle, while the *Cetraria* is fed mostly to sheep. The lichens are steeped in hot water before being fed, and a little barley or oatmeal and salt are sometimes added.—F. W. WOLL.

The mustard oil content of rape and of oil cakes, A. SCHUSTER and MECKE (*Chem. Ztg., 1892, pp. 1954, 1955*); and ULBRICHT (*Landw. Vereinssch. balt. cent. Ver., 1893, pp. 65, 66*).—It is known that the oil-bearing seeds of *Cruciferæ* contain substances which are transmitted to the oil cake, and which, when the latter is treated with water, may give rise to the evolution of mustard oil. Experience has shown that this mustard oil renders the oil cake not only distasteful to the animals, but unwholesome also. When the quantity is sufficient it may even cause death. Prof. Emmerling, of Kiel, mentions a case in which 80 or 90 cows on one farm were affected. Prof. Ulbricht, of the Dahme Station, mentions cases in which the calves of cows fed ground black mustard either died soon after birth or had serious attacks of diarrhea.

There is also a general belief that the quality of milk and butter is affected by feeding cake containing much mustard oil, especially if the cake is stirred up with water before feeding. In view of these facts, Ulbricht was led to recommend in a previous paper that rape cake yielding more than 0.5 per cent of mustard oil be fed dry, and that such cake should not be fed to animals pregnant or suckling young.

In the same paper Ulbricht mentioned finding the following percentages of mustard oil in various samples: Indian rape 0.094 and 0.154; winter rape 0.116; summer rape 0.06; seed of winter rape 0.032; seed of summer rape 0.074; black mustard 1.026; rape cake 0.4, 0.55, 0.69, and 1.03 per cent.

Calculating the proportion between the yield of mustard oil by the rape seed and by the cake, Schuster and Mecke found that the cake yielded proportionally much more mustard oil than the original seed. An explanation of this discrepancy was found in the method of analysis.

They found that in practice it was customary to warm the pulverized rape seed previous to the extraction of its oil, and that this warming nearly tripled the yield of mustard oil from the oil cake; in other words, that the warming of the seed was favorable to the development of the mustard-oil-yielding substances of the seed. They showed that the method heretofore employed in testing rape seed, which omitted this warming, yielded only a fraction of the mustard oil. They therefore came to the conclusion that the pure rape seed contained substances which by warming were altered so as to yield mustard oil when mixed with water; and that in view of this fact it was incorrect to assume from any existing studies that rape cake actually contained mustard seed.*

* A common method of testing rape cake for mustard seed has been to mix the cake with water and notice the odor of mustard oil.

The result reached by Schuster and Mecke was so novel and surprising that their experiments were repeated by Ulbricht. He found the following amounts of mustard oil when the sample was not heated, and when it was heated for thirty minutes in a closed flask at 70° C.:

	Mustard oil (per cent).
White mustard:	
Powdered seed not heated	Trace.
Powdered seed heated	0.052
Winter rape:	
Seed not heated	0.053
Seed heated without shaking	0.126
Seed heated and shaken six times	0.161
Ground rape seed:	
Not heated	0.123
Same, prepared for expression of the oil	0.347
Press cake from the above	0.345

These results corroborate those of Schuster and Mecke in showing that heating the seed increases the yield of mustard oil, and in showing the error of condemning rape cake yielding more than 0.5 per cent of mustard oil. It is left to further investigation to fix the limits of mustard oil for pure press cake.

The method used by Schuster and Mecke in determining mustard oil was as follows: Fifty grams of material was mixed in a liter flask with 300 c. c. of water and allowed to stand at a temperature of about 20° C., with frequent shaking, for five hours. The mustard oil was then distilled off with the aid of steam, and collected in alcoholic ammonium chloride. The distillate was allowed to stand for twelve hours, and the mustard oil then determined by silver nitrate.

Ulbricht's method differed somewhat from this, and was as follows: Twenty-five grams of ground material was mixed with 150 c. c.[3] of water and allowed to stand thirty minutes, with frequent shaking; after which the mustard oil was distilled off with the aid of steam, and collected in alcoholic ammonium chloride. To the distillate was added 25 c. c. of a potassio-mercuric iodide and 4 c. c. of potassium cyanide, and the solution heated in a water bath. After standing twelve hours, the precipitated sulphide of mercury was collected on a filter, dried, and weighed.—E. W. A.

Effect of salt on digestion, E. von Wolff and J. Eisenlohr (*Landw. Jahrb., 22 (1893), pp. 605–627*).—Experiments by Stutzer* have shown that common salt improves the solvent action of artificial digestive fluids on albuminoids. In other words, a higher rate of digestibility was found for the albuminoids of foods when salt was added to the digestive fluids than when it was left out.

The object of the present experiments was to study this question on living animals. Accordingly, three sheep in good condition were fed in three separate trials, receiving hay alone in the first, hay and brew-

* E. S. R., vol. II, p. 526.

ers' grains in the second, and hay and field beans in the third trial. Each trial comprised three periods. In the first no salt was fed, but in the second 4 grams and in the third 8 grams of common salt was added to the fodder of each sheep daily. The experiments were conducted like ordinary digestion experiments.

The results of these trials fail to show that the salt given had any general effect in increasing the digestibility of any food ingredient. In the case of the hay and brewers' grains fed together, the average coefficients for the protein and fat were slightly less with salt than without it, while those for nitrogen-free extract and cellulose were correspondingly higher. The differences were in all cases small and lacking in uniformity. They might safely be accounted for by the individuality of the animals, as these seemed to differ considerably under like treatment.

In addition to determining the coefficient for the protein by the difference between the amount eaten and excreted, allowance was made for the metabolic nitrogen as found by treating the fresh feces with acid pepsin solution, and the air-dry feces with both pepsin and pancreas solutions. The digestibility of each ration was also determined by Stutzer's method of artificial digestion. The average coefficients for the protein as found by the different methods are shown in the following table:

Percentage of protein digested with and without salt.

Food.	Salt per head.	Natural digestion.			Artificial digestion.
		Without treatment of feces.	Treatment of feces with—		
			Pepsin.	Pepsin and pancreas.	
	Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Hay, alone	0	57.8	72.2	79.8	80.4
Do	4	57.4	73.9	78.0	78.3
Do	8	58.3	74.4	76.6	78.0
Hay and brewers' grains	0	69.6	80.2	84.7	83.0
Do	4	69.5	81.2	85.3	81.3
Do	8	67.5	80.4	85.4	82.8
Hay and field beans	0	74.2	83.7	84.6	87.3
Do	4	74.5	82.9	85.4	84.6
Do	8	74.3	82.1	84.9	85.1

These figures show no differences in digestibility due to the salt added. They also show that the results of artificial and natural digestion agree only when allowance is made for the metabolic nitrogen contained in the solid excreta.

These experiments were continued with a horse weighing about 1,100 pounds. The trial lasted from December, 1891, to June, 1892. The horse received rations of hay and oats, hay, oats, and wheat straw, and the same with field beans. Each of these three rations was fed without salt and with 20 grams of salt per day, and the hay and oats ration was also fed with 40 grams of salt. The average results follow:

Coefficients of digestibility with and without salt.

Food.	Total dry matter.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Hay and oats:					
Without salt	58.86	64.48	43.14	36.43	71.39
With salt	58.88	63.56	42.16	37.45	71.18
Hay, oats, and wheat straw:					
Without salt	57.48	66.84	49.65	25.06	70.94
With salt	57.45	66.24	44.37	29.06	69.86
Hay, oats, wheat straw, and field beans:					
Without salt	56.55	70.94	34.63	23.86	70.16
With salt	56.75	69.48	35.40	27.37	69.53

As in the case of sheep, the results with and without salt in general agree quite closely, and show no marked effect of the salt. The digestibility of the crude fiber appears to be somewhat improved by feeding salt, while that of the other nutrients is diminished rather than increased by salt.

In conclusion, the authors state that while their results fail, on the whole, to show any positive favorable influence of salt on the rate of digestibility, they do not dispute the good effect which salt may have on the general condition of the animal, and in certain cases on digestion, as in the case of a deficiency of hydrochloric acid in the digestive juices.—E. W. A.

Effect of muscular work on the excretion of phosphoric acid, F. KLUG and V. OLASAVSKY (*Arch. ges. Physiol., 54 (1893), pp. 21–26*).—Preysz* found that in the case of man the excretion of phosphoric acid was increased by muscular work. Experiments by the authors on a dog fully corroborated this and the statements of others, that work increased the excretion of phosphoric acid. During ten days at rest the animal excreted in the urine on an average 0.3175 grams of phosphoric acid per day. When put to hard work (drawing a sled) the amount increased to 0.57 grams. On the following day the amount dropped to 0.28 grams.

As to the cause of this increase, the authors believe it to be due, at least in a large measure, to the lactic acid formed in the muscles during work, and in a smaller measure perhaps to the carbonic acid formed. In support of this they show that from fresh bones and fresh meat much more phosphoric acid was dissolved by water containing lactic acid or carbonic acid than by pure water; and that in an experiment on a dog the excretion of phosphoric acid in the urine was noticeably increased by adding lactic acid to the food.—E. W. A.

Studies on the bacteria in hens' eggs, and suggestions for keeping eggs, ZÖRKENDÖRFER (*Arch. Hyg., 16 (1893), pp. 368–401*).—A large number of spoiled eggs were examined with reference to the bacteria present, and experiments were made to demonstrate the connection between the bacteria and the spoiling.

* Ungar. Arch. Med., 1, p. 38.

The kinds of bacteria found were very numerous, and it is believed that further investigations would reveal other forms capable of changing the egg. Several of the forms found were grown in pure cultures. When eggs were inoculated with these under favorable conditions they spoiled in a short time. The forms noticed are divided into two groups: (1) Those producing sulphuretted hydrogen, to which the odor of the rotten egg is largely due, and (2) those causing a greenish-blue color. The characteristics of some sixteen different forms were studied and described.

As to the manner in which the bacteria get into the eggs, the experiments made indicate that neither the outer shell nor the membrane next the shell are impervious to bacteria. Fresh eggs were inoculated with different forms of bacteria by placing the bacteria on the outside of the shell. After a few days colonies of these bacteria were found growing on the inside of the shell. Fresh eggs were also laid in bouillon cultures, and after a few days the forms of bacteria contained in the bouillon were recognized in the egg. In other trials eggs were blown, the shells filled with nutritive gelatin, and the ends sealed up with paper. These artificial eggs were then sterilized in a steam bath, after which they were placed on a mass of egg which had become putrid. When, after a few days, the shells were removed without disturbing the gelatin, a number of colonies of bacteria were found on the side next to the spoiled egg. These colonies were separated from one another, indicating, as in former trials, that the bacteria enter the shell at particular places.

Some practical observations were made bearing on the keeping of eggs. It was found that a moist atmosphere was favorable to spoiling, probably because the moist air was more favorable to the growth of the bacteria on the outside of the shell.

A low temperature was unfavorable, but was not proof against spoiling, since nearly all of the bacteria found grew in a refrigerator, although slowly.

The majority of the bacteria found were killed by a temperature of about 50° C. (122° F.). In view of this it is suggested that heating eggs one or two days at that temperature, and then storing them in a dry place would probably be effectual in most cases, although this does not entirely preclude the action of bacteria which might get on the outside of the shell.

The most effectual precaution suggested is that of excluding the supply of oxygen which the bacteria require for growth. This is often done by placing the eggs in lime water, but with unsatisfactory results, as it imparts an unpleasant taste to the eggs. The author proposes to effect this by coating the shell with a lacquer of some kind which closes the pores of the shell air-tight. Practical trials of this method gave very encouraging results. A large number of eggs were inoculated with bacteria and then some of the eggs were coated. Those not

coated all spoiled within a week, but the coated eggs kept perfectly for two months, without change in color, flavor, or odor. The exact nature of the coating is not given.—E. W. A.

The phosphates of milk, DUCLAUX (*Ann. Inst. Pasteur, 1893, pp. 2–17; abs. in Chem. Ztg., 1893, Repert., p. 79*).—According to the author, phosphates exist in milk in soluble form and in insoluble form, *i. e.*, in suspension. The insoluble phosphates consist of phosphates of iron, aluminum, magnesium, and calcium. The soluble portion appears to be made up of a mixture of an equal number of molecules of tricalcic phosphate, sodium phosphate, and sodium citrate. In the case of all the samples of milk examined the insoluble portion contained about twice as much lime and calcium phosphate as the soluble portion.

The following table shows the similarity of milk from different regions in respect to its phosphates:

Phosphates and other ash constituents of milk from various sources.

	Milk from Cantal.	Milk from Norway.	Milk from Normandy.	Phosphate milk, I.	Phosphate milk, II.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Total lime as calcium phosphate	0.337	0.329	0.311	0.336	0.350
Excess of P_2O_5, mostly combined with Al Fe, Mg and Na	0 065	0.062	0.051	0.073	0.063
Other mineral constituents	0.346	0.379	0.388	0.357	0.337
Total ash	0.748	0 750	0.750	0.766	0.750

By "phosphate milk" is understood a milk in which the phosphates are supposed to have been increased by feeding phosphate of lime (see E. S. R., vol. III, p. 503).

The above analyses show that such milk, in spite of the claims for it which bring it a much higher price, contains no more phosphates than other milk. The close agreement of the mineral constituents in the various samples of milk is also of interest in connection with milk inspection. It indicates that the addition of either soluble or insoluble phosphates could be detected from the change it would cause in the relation of soluble and suspended phosphates.—E. W. A.

The action of heat on milk, H. D. RICHMOND and L. K. BOSELEY (*Analyst, June, 1893, pp. 141, 142*).—These studies were on the effect of heat on the specific rotary power of milk sugar. In a previous paper by one of the authors (*Analyst*, December, 1892, p. 225) it was stated that the specific rotation of milk sugar was reduced by heating. The object of these studies was to discover, if possible, a constant factor for a unit of time. Samples of milk were heated in closed vessels for from one and one half to three hours at 100° C. The results show that "even in one quarter of an hour the change may be detected by a delicate polariscope," and that "samples heated for the same time may show enormous variation." No change was produced in the rotation by adding ammonia to the solutions or by allowing them to stand for some hours. The reducing power of Fehling's solution remained practically constant in the heated and unheated milk.—E. W. A.

The making of cheese (*Ontario College Sta. Bul. No. 88, Apr. 17, 1893, pp. 8*).—This bulletin contains directions for making spring, summer, and fall cheese, and was prepared by committees of the Special Dairy School at the Ontario Agricultural College.—E. W. A.

Fifth general meeting of the Association of German Agricultural Experiment Stations (*Landw. Vers. Stat., 42, pp. 97–178*).—The fifth general meeting of the Association of German Agricultural Experiment Stations was held in Berlin, December 11 and 12, 1892. Besides the representatives of German experiment stations, the German agricultural bureau, fertilizer manufacturers, and German potash works, there were present as guests Prof. E. W. Hilgard, of California; Prof. W. O. Atwater, of Connecticut; Prof. Adolf Mayer, of Wageningen, Holland; Dr. E. Meissl, of Vienna, and others.

The meetings were presided over by Prof. Nobbe in place of Prof. Gustav Kühn, deceased. In his opening address the acting president referred to the loss sustained by the Association during the past year in the death of Prof. Gustav Kühn and Dr. Schrodt.

Prof. H. Schultze, director of the experiment station at Brunswick, was chosen president for the ensuing year.

The following is a brief summary of the deliberations of the Association regarding methods of investigations:

Determination of phosphoric acid.—The results of comparisons by thirty stations of the percentage of phosphoric acid found by the molybdate and citrate methods are reported. In a solution containing 155.4 mg. of phosphoric acid, the citrate method gave from 0.4 mg. less to 4.1 mg. more phosphoric acid than the molybdate method. The agreement between the two methods was not as close as on previous occasions. The agreement of the results obtained by different analysts by the citrate method was more satisfactory than by the molybdate method. It is believed that the chief source of error in the molybdate method lay in precipitating the phosphoric acid with magnesia mixture in a solution containing about 2.5 per cent of ammonia. It was recommended that in future studies of methods this apparent error be corrected. In such a solution the phosphoric acid is either not completely precipitated or the precipitate differs somewhat from the normal ammonium magnesium phosphate, since, according to Neubauer, free phosphoric acid may be volatilized during incineration, giving a too low result. The phosphoric acid precipitated from strongly ammoniacal solutions is under some conditions noticeably low. It becomes necessary, therefore, to precipitate from a very weakly ammoniacal or a neutral solution.

The reporter suggested that the comparisons be continued with the changes mentioned.

The discussion brought out quite a difference of opinion as to the reliability of the method of precipitating from neutral or ammoniacal solutions. Dr. Loges had found that the precipitation from neutral solutions often gavewrong results, especially when the ammonia was added

before the precipitate had completely separated out of the neutral solution. Magnesia was thrown down under such conditions, and the precipitate showed a reaction for ortho-phosphate. Others also believed that neutralization was entirely useless.

The recommendation of the Association was that a phosphoric acid solution of known strength be sent out to all the members for testing by the following methods: (1) Precipitation with magnesia mixture, according to the new Fresenius molybdate method, *i. e.*, neutralizing and then adding 7 c. c. of 10 per cent ammonia; (2) precipitation with a magnesia mixture containing an unusually large quantity of ammonia and ammonium chloride (Halle modification); (3) precipitation from a solution not neutralized, made by dissolving the yellow molybdic precipitate in as small a quantity of ammonia as possible (Wagner method).

Examination of Thomas slag.—At the Halle meeting of the Association it was recommended to retain sulphuric acid as the solvent in making up solutions for analysis, but that comparisons be made of this with solution in hydrochloric acid by digesting for two hours in a boiling water bath. These comparisons were made, but the result was not favorable to the hydrochloric acid method. Hydrochloric acid was declared to be unreliable and it was decided to adopt sulphuric acid exclusively for the solution of Thomas slag phosphate.

Attention was called by H. Schultze to the disadvantage which may result from grinding and screening the sample, and the proposition was made that in the preparation of Thomas slag for analysis the material should not be screened except in cases where it is necessary to do so in order to get an average sample. Further, that the portion of the sample retained for the control analysis be preserved in tight-stoppered bottles in a cool place for three months. The suggestions were adopted.

Direct determination of nitrogen in Chili saltpeter.—The reporter recommended for this purpose Gustav Kühn's zinc-iron method. The indirect method, determining the nitrogen by difference, was reported to be unreliable. The recommendation was adopted.

A paper was presented by A. Devarda, describing his method for the determination of nitric nitrogen (E. S. R., vol. IV, p. 676). The method gave very close results on chemically pure nitrate of potash and nitrate of soda.

Methods of potash determination.—The committee on fertilizer analysis presented some recommendations looking toward the adoption of an official method for potash determination. They considered it essential that the platinic chloride used be pure, and especially so in regard to iridium oxide, platinous chloride, sulphuric acid, and nitric acid. Pure potassium chloride should be used for testing platinic chloride. The method recommended was to dissolve 20 grams of substance in 1 liter, using 100 c. c. for analysis. To this add 10 c. c. of hydrochloric acid and barium chloride until the sulphuric acid is all precipi-

tated, when the solution is made to 2 liters and filtered. A slight excess of barium chloride need not be removed, but every trace of sulphuric acid should be precipitated. Definite quantities of platinic chloride are recommended in case of different potash salts. After the platinic chloride is added, the solution is evaporated to dryness, moistened with a few drops of water, cooled, and 96 per cent alcohol added. The potassio-platinic chloride precipitate is collected in a Gooch crucible, dried at 120° C., and weighed. In the presence of salts containing magnesium chloride, the sample is to be mixed with freshly ignited caustic lime.

The committee recommended that further investigations be made on the factors to be used in calculating the potassium sulphate and potassium oxide from the potassio-platinic chloride precipitate, and as to whether in the determination of potassium sulphate in sulphate of potash and double sulphate of potash and magnesia a correction should be made. It was decided to investigate the method for another year before adopting it as official.

Dr. Meissl called attention to the necessity of using pure platinic chloride, as a prime factor in potash determination, and to the difficulty of securing absolutely pure platinic chloride. Besides impurities of iridium oxide, platinous chloride, and traces of nitric acid, it often contained sulphuric acid and silver chloride. Further than this, it often happened that the residue from the evaporation of platinic chloride was not entirely soluble in alcohol. He regarded the weighing of the reduced platinum as somewhat safer than weighing the potassio-platinic chloride precipitate. The practice at his station was to reduce the platinum in a wide test tube in a current of illuminating gas, heat the platinum with a little water and hydrochloric acid, filter, incinerate, and weigh.

Prof. Hilgard remarked that while the weighing of the double salt in a Gooch crucible gave satisfactory results in skilled hands, he preferred weighing the reduced platinum. This he did in a small platinum crucible, the inside of which was coated about halfway up the side with a layer of platinum sponge. The platinum sponge aided the decomposition of the double salt, so that the latter took place rapidly and quietly at a comparatively low temperature. As a matter of fact, the results by this method were always slightly lower than those obtained by weighing the double salt.

Fertilizer control.—Prof. H. Schultze reported on this subject. A form for a contract between fertilizer manufacturers or dealers and experiment stations was presented. In this, the control station agrees on its part to publish annually in a journal to be agreed upon a list of the firms placing themselves under its control; to analyze samples of the fertilizers manufactured by these firms free of cost to the senders when samples are properly taken; to analyze the fertilizer samples within twelve days after their receipt, or in case this is impossible to notify the firm and the sender of the sample; to send copies of the results to both

the sender of the sample and the firm manufacturing it; and to make the analyses according to the official methods. The firm on its part agrees to sell all goods under guaranty of composition, and to guarantee also the general condition of the goods and their freedom from injurious materials; to make compensation for any lot of goods found to be below the guaranty; and to pay the experiment station for the analyses made according to a fixed tariff. The form as presented was adopted after some discussion.

Feeding stuffs control.—Regulations governing the sale and the control of feeding stuffs, very similar to those given in E. S. R., vol. III, p. 753, were adopted.

Prof. Emmerling stated that in some sections more than half of the bran sold was adulterated. Prof. Meissl stated that at the Vienna Station certain feeding stuffs containing spores of plant blights had been fed to pigs. No injury was observed to the health of the animals, but the spores excreted were found to be uninjured and to germinate readily, thus favoring a distribution of the disease. He had seldom found bran adulterated, but had often found considerable quantities of spores of rusts, blights, etc. Ulbricht stated that at the experiment station in Dahme every sample of bran was examined as to its content of weed seeds. The seeds thus separated were tested as to their vitality. He had also noticed large amounts of spores in bran. Prof. Adolf Mayer stated that the Holland stations were fitted out with appliances for determining whether and to what extent a feeding stuff was adulterated, and to recognize the materials used in such adulteration.

Soil analysis.—A paper prepared by Prof. Julius Kühn on the subject of soil analysis was read, in which some changes in the methods adopted in 1890 were suggested (E. S. R., vol. II, p. 524). Prof. Hilgard spoke at considerable length on chemical and mechanical soil analysis.

Seed testing and seed control.—Recommendations as to the amount of subsamples to be taken, tests for trueness to name, origin, purity, volume weight, germination test, and the duration of the germination test, passed the second reading.

Miscellaneous business.—A committee appointed to consider the matter of the Association's making an exhibit at the World's Fair reported unfavorably, for the reasons that it was doubtful whether at that date space could be obtained, that sufficient funds could not be raised, and that the time was too short for the preparation of a creditable exhibit.

The request of the German Agricultural Society that the Association coöperate with it in its experiments on the preservation of barnyard manure, which are to be continued for four years, was presented by Dr. Vogel, chemist to the Society.

Prof. Atwater spoke upon the desirability of closer relationship between the experiment stations of different countries, and suggested the formation of an international commission.—E. W. A.

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The action of heat on milk, H. D. RICHMOND and L. K. BOSELEY.—*Analyst, June, 1893, pp. 141, 142.*

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Analysis of a cheese made from separator skim milk, L. CARCANO.—*Staz. sper. agr. Ital., 24, pp. 5–8; abs. in Chem. Centralbl., 1893, I, No. 19, p. 895.*

The effect of exclusion of air on the ripening of Emmenthaler cheese (*Ueber den Einfluss des Luftabschlusses auf die Reifung des Emmenthaler Käses*), E. VON FREUDENREICH and F. SCHALLER.—*Schweiz. Wochensch. Pharm., 31, pp. 78–81; abs. in Chem. Centralbl., 1893, I, No. 15, p. 706.*

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Novelties in the manufacture of rice starch (*Neuerungen in der Fabrikation von Reisstärke*), H. SCHREIB.—*Chem. Ztg., 1893, No. 44, pp. 777–780.*

The purification of beet juice (*Ueber die Reinigung der Rübensäfte*).—*Wochenschr. Central-Ver. Rübenzuck. Ind., 1892, No. 11, p. 158, 159.*

The application of electricity in purifying juice (*Die Anwendung der Electricität bei der Saftreinigung*), A. STIFT.—*Wochenschr. Central-Ver. Rübenzuck.-Ind., 1893, No. 1, p. 2.*

The effect of lime and alkalies on inverted sugar (*Ueber die Einwirkung von Kalk*

und Alkalien auf Inventzucker), L. JESSER.—*Oesterr. ungar. Zeitsch. Zuckerind. u. Landw., 1893, Heft 2, pp. 239–253.*

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The judgment of wine from its chemical analysis (*Die Beurtheilung der Weine auf Grund der chemischen Untersuchung*), J. NESSLER.—*Chem. Ztg., 1893, No. 33, p. 577.*

Studies on the structure of wool fiber (*Ueber Strukturverhältnisse von Wollhaaren mit Anknüpfung an die Kohlschmidt'sche Erörterung der Breslauer Probeschur und die letztere selbst*), W. VON NATHUSIUS.—*Landw. Jahrb., 22 (1893), Heft 4, pp. 469–502.*

History of the horseshoe (*Die Hufeisenfunde in Deutschland, namentlich in Südbayern, und die Geschichte des Hufeisens*), R. BRAUNGART.—*Landw. Jahrb., 22 (1893), Heft. 3, pp. 325–434.*

Agricultural machinery for the culture of roots (*Altes und neues über landwirthschaftliche Maschinen, mit besonderer Berücksichtigung der Rübenculturgeräthe*), H. RITTER.—*Oesterr. ungar. Zeitsch. Zuckerind. u. Landw., 1893, Heft 2, pp. 171–193.*

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EXPERIMENT STATION NOTES.

ALABAMA COLLEGE AND STATION.—The college and station have met with a severe loss in the death of N. T. Lupton, M. D., LL. D., professor of general and agricultural chemistry in the college, chemist of the station, and State chemist, which occurred June 11, at Auburn, Alabama.

IDAHO STATION.—The station council and staff have been organized as follows: Franklin B. Gault, president of the University of Wyoming, chairman; Charles P. Fox, M. S., director, agriculturist, and horticulturist; John E. Ostrander, A. M., C. E., irrigation engineer; Charles W. McCurdy, D. Sc., chemist; L. F. Henderson, Ph. B., botanist; John M. Aldrich, M. S., entomologist; and John E. Bonebright, B. S., meteorologist.

INDIANA COLLEGE AND STATION.—S. G. Wright has been appointed assistant botanist of the station, vice Miss K. E. Golden, who becomes assistant in biology in Purdue University. A. W. Bitting, professor of veterinary science in the Florida Agricultural College, has been elected professor of veterinary science in Purdue University and veterinarian of the Indiana Station, vice W. L. Williams. George R. Ives has been appointed assistant agriculturist of the station.

A greenhouse for pot experiments is in course of erection at the station. It is a substantial glass structure 40 by 20 feet, and will be provided with about 150 feet of track for the trucks carrying plants growing in pots.

LOUISIANA SUGAR SCHOOL.—The third session of the Sugar School connected with the station at Audubon Park, New Orleans, Louisiana., will begin October 1, 1893, and close July 1, 1894. "The second session has been well attended by students from Spain, the Hawaiian Islands, Cuba, Nebraska, Kansas, and Louisiana. The object of the school is to produce experts in the sugar industry, and to this end a regular course has been arranged, covering thorough instruction in the growing of cane, beets, and sorghum; designing, construction, and operation of sugar houses; and the practical manufacture of sugar and the chemistry of its products. For those prepared for entering upon this course two years will be necessary for its completion. This course leads to graduation. There is also an irregular course designed to meet the wants of the sugar-makers, engineers, and planters who have not the time for the regular course, but wish to add to their practical accomplishments the knowledge of the principles upon which their work is done. This course may be taken at any time, and will consist of such studies from the regular course as the student may elect."

"During the harvest, lasting usually three months, the sugar house will be run by the students and the professors in the experimental manufacture of sugar. At other times it will be used by the professor of mechanics and the instructors in sugar-making for familiarizing the students with the use of the machinery and with the art of sugar-making. After the crop season is over the low-grade sugars are melted and used by the students for instruction in sugar-making and centrifugaling. Each student takes his turn at firing the boilers, weighing the coal and water consumed, melting sugar, boiling it to grain in the vacuum pan, and centrifugaling the masse cuite. At the end of this round he fills up properly and returns through his instructor to the director of the school carefully prepared tables of the results at every point in the process of manufacture, and of every point arising in the mechanical execution of the work, from firing with the coal to the weight of the condensing water evaporated and the final consumption of coal per pound of sugar made."

The faculty consists of William C. Stubbs, A. M., Ph. D., director; Thomas P. Hutchinson, assistant director; J. T. Crawley, A. M., chemist; J. L. Beeson,

Ph. D., chemist; R. T. Burwell, M. E., mechanical engineer; E. E. Olding, sugar-maker; and A. Lehman, B. S. A., chemist.

MARYLAND STATION.—C. V. Riley, of the U. S. Department of Agriculture, has been appointed entomologist of the station.

In a test of 40 varieties of wheat just completed the average yield was over 30 bushels per acre. Seven or 8 varieties yielded over 40 bushels, and 2 varieties—the Wisconsin Triumph and Fultz—over 45 bushels. It was thought that the large yield was principally due to a top dressing of stable manure applied with a manure-spreader in January.

NEW YORK CORNELL STATION.—Fred W. Card has been elected associate professor of horticulture in the University of Nebraska.

NORTH DAKOTA STATION.—J. B. Power has been elected director, vice H. E. Stockbridge, Ph. D.

PENNSYLVANIA STATION.—The last legislature passed an act appropriating $3,000 a year for two years to the station "for the purpose of conducting experiments and investigations in the culture, curing, and preparation of tobacco. These experiments, which have already been initiated at two points in Lancaster County, are to be under the management of the Tobacco Growers' Society of Lancaster County, and such other responsible associations as may care to engage in such work, but subject to the direction and control of the station. The actual work of experimentation is to be carried on by the respective associations, but the analyses and investigations connected therewith are to be made by the station and the results of the experiments published in its annual report. It is further provided that no part of the appropriation shall be used for the purchase of land, and that experiments shall be carried on under the act in not less than two, nor more than five, separate localities. Provision is also made for the publication of results in the form of bulletins, one copy of each of which is to be sent to every newspaper in the State."

TEXAS STATION.—J. H. Connell, M. S., professor of agriculture in the Mississippi College, has been appointed director of the station, vice G. W. Curtis, M. S. A.

WYOMING COLLEGE AND STATION.—The following appointments have been made by the board of trustees: E. I. Antrim, Ph. D., professor of English; W. C. Knight, A. M., professor of mining and metallurgy, and geologist of the station; I. M. Morse, Ph. B., assistant professor of French and German; J. D. Conley, Ph. D., physicist of the station.

ONTARIO.—The following statistics of agriculture in Ontario are taken from a recent circular issued by the Bureau of Industries: Population 2,114,321; number of acres of cleared land 11,988,426; horses 688,814; cattle 2,029,140; sheep 1,850,473; pigs 996,974; poultry 7,078,973; value of farm lands, buildings, implements, and live stock, $979,977,244.

The area, produce, and value of field crops in Ontario in 1892.

Field crops.	Acreage.		Products in 1892.	Yield per acre.		Value of crop of 1892.	Market price.	
	1892.	Eleven years.		1892.	Eleven years.		1892.	Eleven years.
			Bushels.	*Bush.*	*Bushels.*		*Cents.*	*Cents.*
Fall wheat	966,522	908,636	20,492,497	21.2	20 1	$14,488,195	70.7	88.0
Spring wheat	651,202	571,525	8,290,395	12.7	15.4	5,620,888	67.8	87.7
Barley	499,225	721,062	12,274,318	24.6	25.9	5,069,293	41.3	53.7
Oats	1,861,469	1,681,229	64,758,053	34.8	35.1	19,945,480	30.8	35.5
Rye	73,073	100,857	1,132,504	15.5	16.2	631,937	55.8	59.7
Peas	774,732	678,578	14,494,430	18.7	20.6	8,551,714	59.0	61.4
Corn (in the ear)	181,463	202,877	11,229,498	61.9	....	2,953,358	26.3	31.6
Corn (tons for silo)	91,403		948,907	10.38	....	1,897,814	......	....
Buckwheat	125,104	74,309	2,521,214	20.2	20.4	1,063,952	42.2	41.6
Beans	33,249	26,841	535,931	16.1	17.7	529,500	98.8	114.4
Potatoes	145,703	154,563	12,289,817	84.3	118.0	6,194,068	50.4	45.3
Mangel-wurzels	22,026	19,772	10,350,474	470.0	440.0	828,038	......	....
Carrots	9,941	10,379	3,827,361	385.0	354.0	478,420	......	....
Turnips	129,627	107,187	63,541,641	490.0	418.0	6,354,164	......	....
			Tons.	*Tons.*	*Tons.*			
Hay and clover	2,515,367	2,310,938	4,384,838	1.74	1.39	35,955,672	$8.20	$10.08
Total	8,080,206	7,568,753	....	......	....	110,562,493	......	....

"The average wages paid to laborers per year were $156 with board, and $253 without board; for the working season $16.52 was the average per month with board and $25.92 without board; domestic servants averaged $6.21 per month.

"The average temperature for the six growing months (April-September) in 1892 was 58.61°, being nearly 1° above the average season of eleven years. The total sunshine for the same months was 1,346.9 hours, or eight hours below the average. The rainfall amounted to 20.16 inches as compared with 15.45 inches, the average season's rainfall for the eleven years."

INTERNATIONAL EXHIBITION OF FRUIT CULTURE.—The Society of Fruit Culture of Russia announces an international exhibition of fruit culture, to be held under its auspices at St. Petersburg in the autumn of 1894. Its object is stated to be to show "the present condition in Russia and other countries of the cultivation of fruits and vegetables, viticulture, the cultivation of medicinal plants, horticulture, and the manufacture of their products."

A congress of pomologists will be convened simultaneously with the exhibition, and all persons interested in horticulture and pomology, whether in Russia or in other countries, are invited to participate in the exhibition. The classification for the exhibition is as follows: (1) Fresh fruits; (2) fresh vegetables; (3) dried fruit and vegetables, preserved or treated by other processes; (4) wine, cider, perry, and other fruit beverages; (5) hops and medicinal herbs; (6) seeds; (7) fruit trees and bushes; (8) horticultural implements and appliances, and technicality of production; (9) literary, scientific, and educational accessories, collections, plans, etc.

Persons desirous of further information are referred to the office of the International Exhibition of Fruit Culture, 1894, Imperial Agricultural Museum Fontanka, 10 St. Petersburg, Russia.

FOREIGN VISITORS TO THE WORLD'S FAIR.—A committee of ten members of the Hungarian National Agricultural Society of Buda-Pesth is to visit this country to attend the World's Columbian Exposition and study our agricultural colleges and experiment stations, as well as our agriculture in general. For this purpose they have planned quite extensive journeys to various parts of the country.

Prof. Dr. Alexander Herzfeld, lecturer at the Royal Agricultural and Technical Institute at Berlin and director of the Chemical Laboratory of the German sugar-beet industry, will visit this country under a commission from the Imperial Government of Germany to study our agriculture, and especially experimental work in sugar-beet and sorghum culture and sugar-making from these crops. He will be accompanied by Dr. Bartz, director of a large industrial establishment at Brunswick.

Dr. Max Sering, author of an important work on American agriculture entitled *Die Landwirthschaftliche Konkurrenz Nordamerikas in Gegenwart und Zukunst* (Leipzig, 1887, pp. 759), is among the visitors to the Fair.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

MAY, 1893.

DIVISION OF BOTANY:

Bulletin No. 13, part II, June 1, 1893.—Grasses of the Pacific Slope, Including Alaska and the Adjacent Islands.

DIVISION OF ENTOMOLOGY:

Insect Life, vol. V, No. 4, April, 1893.

Bulletin No. 29, October 31, 1892.—Report on the Bollworm of Cotton.

DIVISION OF ORNITHOLOGY AND MAMMALOGY:

North American Fauna, No. 7, December, 1892.—The Death Valley Expedition; a Biological Survey of Parts of California, Nevada, Arizona, and Utah, part II.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. IV, No. 7, February, 1893.

DIVISION OF STATISTICS:

Report No. 104 (new series), May, 1893.—Condition of winter grain; Mowing lands and pastures; Progress of cotton-planting; Spring plowing; Changes in crop areas; Temperature and rainfall; Notes from reports of State agents; the cotton crop of India for the year 1892-'93; European crop report for May, 1893; Freight rates of transportation companies.

Report No. 7 (miscellaneous series), February, 1893.—An Agricultural Survey of Wyoming.

WEATHER BUREAU:

Monthly Weather Review, March, 1893.

MAY, 1893.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Bulletin No. 101, May, 1893.—Further Examination of California Prunes, Apricots, Plums, and Nectarines.

COLORADO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 22, January, 1893.—Preliminary Report on the Duty of Water.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Annual Report, 1892.

AGRICULTURAL EXPERIMENT STATION OF FLORIDA:

Bulletin No. 18.—Grasses, Forage Plants, Tomato Blight.

Bulletin No. 19, 1892.—Tobacco.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 45, April, 1893.—Field Experiments with Fertilizers.

MAINE STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 4 (second series).—Testing Cream and Milk, Fat Test and Lactometer.

Annual Report, 1892, part III.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 46, March, 1893.—Commercial Fertilizers.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 52, April, 1893.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 50 (new series), January, 1893.—Summary of Results of Experiments made in the Manufacture of Cheese During the Season of 1892.

Bulletin No. 51 (new series), March, 1893.—Some Celery Diseases.

Bulletin No. 52 (new series), March, 1893.—Analyses of Commercial Fertilizers.

Bulletin No. 53 (new series), April, 1893.—Feeding Experiments with Capons.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 89, March, 1893.—Coöperative Field Tests During 1891 and 1892.

Bulletin No. 90, April, 1893.—Practical Stock Feeding.

Bulletin No. 90*d*, April, 1893.—Meteorological Summary for North Carolina, March, 1893; Has the Moon any Influence on the Weather?

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 9, March, 1893.—Conditions Affecting the Value of Wheat for Seed; Prevention of Potato Scab.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 47, December, 1892 (Annual Report, 1892).

OKLAHOMA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 5, January, 1893.—Some Soil Analyses.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 32, December, 1892.—Forestry.

AGRICULTURAL EXPERIMENT STATION OF UTAH:

Bulletin No. 20, March, 1893.—Horticultural Department.

Bulletin No. 21, March, 1893.—Feeding Ruminants on Grain Alone; Night Versus Day Irrigation.

VERMONT STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 32, March, 1893.—Oat Smut.

VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE EXPERIMENT STATION:

Bulletin No. 24, January, 1893.—Injurious Insects and Diseases of Plants, with Remedial Measures.

Bulletin No. 25, February, 1893.—Dorset Horn Sheep.

WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 29, January, 1893.—Experiments on Potatoes at the Station; Experiments on Corn at the Outstations.

Bulletin No. 30, 1893.—Sheep.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:

Bulletin No. 35, April, 1893.—Insects and Diseases Injurious to Cranberries.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:

Report of Experimental Farms for 1892.

ONTARIO AGRICULTURAL COLLEGE EXPERIMENT STATION:

Seventeenth Annual Report, 1891.

Eighteenth Annual Report, 1892.

BUREAU OF INDUSTRIES, TORONTO, ONTARIO:

Bulletin No. 42, August, 1892.—Crops and Live Stock in Ontario.

Bulletin No. 43, November, 1892.—Crops and Live Stock in Ontario.

Bulletin No. 44, April, 1893.—Crops and Live Stock in Ontario.

EXPERIMENT STATION RECORD.

VOL. IV. JULY, 1893. NO. 12.

Owing to unavoidable irregularities in the publication of station bulletins and reports, it has been found impracticable to make the abstracts in any one volume of the Record cover the publications issued by the stations during any definite period. The fourth volume of the Record contains, however, abstracts of most of the station publications received by this Office during the year ending June 30, 1893. This concluding number of the volume consists of an author and subject index, and a table of contents which includes a list of publications abstracted and a classified subject list of abstracts. In the subject list the classification adopted for the card index of station literature issued by this Office has been followed as far as feasible. In most cases the titles under each head have been grouped so as to bring related subjects together in accordance with the system of main divisions in the card index. The principal exception to this rule is in the case of articles on field crops, which in many cases are of so general and comprehensive a nature as to render such a classification impracticable. In this group, therefore, the titles are, as far as possible, arranged alphabetically according to the crops experimented on.

The index of subjects has been made with great care and completeness, in the hope that it will be useful, not only as an index to the Record, but also as a guide to the contents of the publications abstracted. The individual entries have been made as brief as is consistent with clearness, and cross references have been occasionally employed. When practicable, each entry gives the name of the institution responsible for the work indexed. This has been found useful to facilitate the examination of the work of individual stations in any line or the finding of the investigations pursued in particular regions.

The references to a large number of foreign articles, which appear in the index, will enable the student having access to foreign journals on agricultural science to readily find extended information on many problems which have been investigated abroad.

INDEX OF NAMES.

INDEX OF SUBJECTS.